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AFRICAN HEADWRAP

# W O N D E R F U L   N E S T S

*FROM "HOMES WITHOUT HANDS"*

BY THE

REV J. G. WOOD, M.A., F.L.S., &c.

With 30 Illustrations



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# WONDERFUL NESTS.

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## CHAPTER I.

### *PENSILE MAMMALIA.*

The HARVEST MOUSE—Its appearance—Reason for its name—Mouse nests—Home of the Harvest Mouse—A curious problem—Food of the Harvest Mouse, and its agility—The SQUIRREL—Its summer and winter “cage”—Boldness of the Squirrel—Materials for the nest, and their arrangement

THERE are not many mammalia which make pensile nests, and we are, therefore, the more pleased to find that one of the most interesting inhabits this country. This is the well-known HARVEST MOUSE, the smallest example of the mammalia in England, and nearly in the world.

This elegant little creature is so tiny that, when full-grown, it weighs scarcely more than the sixth of an ounce, whereas the ordinary mouse weighs almost an entire ounce. Its colour is a very warm brown above, almost amounting to chestnut, and below it is pure white, the line of demarcation being strongly defined. The colour is slightly variable in different lights, because each hair is red at the tip and brown at the base, and every movement of the animal naturally causes the two tints to be alternately visible and concealed.

It is called the Harvest Mouse, because it is usually found at harvest time, and in some parts of the country

it is captured by hundreds, in barns and ricks. To the ricks it would never gain admission, provided they are built on proper staddles, were it not that it gets into the sheaves as they stand in the field, and is carried within them by the labourers. Other mice, however, are sometimes called by this name, although they have no fair title to it ; but the genuine Harvest Mouse can always be distinguished by its very small size, and the bright ruddy hue of the back and the white of the abdomen. Moreover, the ears of the Harvest Mouse are shorter in proportion than those of the ordinary mouse, the head is larger and more slender, and the eyes are not so projecting, so that a very brief inspection will suffice to tell the observer whether he is looking at an adult Harvest Mouse, or a young specimen of any other species.

Mice always make very comfortable nests for their young, gathering together great quantities of wool, rags, paper, hair, moss, feathers, and similar substances, and rolling them into a ball-like mass, in the middle of which the young are placed. I have seen many of these nests, and only once have known an exception to the rule, when the mouse had made its nest of empty and broken nut-shells. The Harvest Mouse, however, surpasses all its congeners in the beauty and elegance of its home, which is not only constructed with remarkable neatness, but is suspended above the ground in such a manner as to entitle it to the name of a true pensile nest. Generally it is hung to several stout grass-stems ; sometimes it is fastened to wheat-straws ; and in one case, mentioned by Gilbert White, it was suspended from the head of a thistle.

It is a very beautiful structure, being made of very narrow grasses, and woven so carefully as to form a hollow globe, rather larger than a cricket ball, and very nearly as round. How the little creature contrives to form so complicated an object as a hollow sphere with thin walls is still a problem. It is another problem how the young



HARVEST MOUSE.

are placed in it, and another how they are fed. The walls are so thin that an object inside the nest can be easily seen from any part of the exterior ; there is no opening whatever, and when the young are in the nest they are packed so tightly that their bodies press against the wall in every direction. As there is no defined opening, and as the walls are so loosely woven, it is probable that the mother is able to push her way between the meshes, and so to arrange or feed her young.

The position of the nest, which is always at some little height, presupposes a climbing power in the architect. All mice and rats are good climbers, being able to scramble up perpendicular walls, provided that their surfaces be rough, and even to lower themselves head downwards by clinging with the curved claws of their hind feet. It is also a noticeable fact, that the joint of the hind foot is so loosely articulated that it can be turned nearly half round, and so permits great freedom of movement. The Harvest Mouse is even better constructed for climbing than the ordinary mouse, inasmuch as its long and flexible toes can grasp the grass-stem as firmly as a monkey's paw holds a bough, and the long, slender tail is also partially prehensile, aiding the animal greatly in sustaining itself, though it is not gifted with the sensitive mobility of the same organ in the spider, monkey, or kinkajou.

As the food of the Harvest Mouse consists greatly of insects, flies being especial favourites, it is evident that great agility is needed. In order to show the active character of the quadruped, one of the Harvest Mice is represented in the act of climbing towards a fly, on which it is about to pounce. Under such circumstances, its leap is remarkably swift, and its aim is as accurate as that of the swallow. Even in captivity, it has been known to take flies from the hand of its owner, and to leap along the wires of its cage as smartly as if it were trying to capture an insect that could escape.

The Harvest Mouse is tolerably prolific, and in the airy cradle may sometimes be seen as many as eight young mice, all packed together like herrings in a barrel.

There is another well-known British mammal which, at all events at one season of the year, may be classed among those creatures who build pensile nests. This is the common Squirrel, so plentiful in well-wooded districts, and so scarce where trees are few.

The Squirrel is an admirable nest-builder, though it cannot lay claim to the exquisite neatness which distinguishes the harvest mouse. As is well known, the Squirrel constructs two kinds of nests, or "cages," as they are popularly called, one being its winter home, wherein it can remain in a state of hibernation, and the other its summer residence. These two nests are as different as a town mansion and a shooting-box, the former being strong, thick-walled, sheltered, and warm, and the other light and airy. The winter cage is almost invariably placed in the fork of some tree, generally where two branches start from the trunk. It is well concealed by the boughs on which it rests, and which serve also as a shelter from the wind. The summer cage, on the contrary, is comparatively frail, and is placed nearly at the extremity of slender boughs, which bend with its weight, and cause the airy cradle to rock and dance with every gust of wind.

As if conscious of the impregnable situation which it has chosen, the Squirrel takes no pains to conceal the summer cage, but builds it so openly, that it can be seen from a considerable distance; whereas the winter home requires a practised eye to detect it. So confident is the animal in the strength of its position, that it can scarcely be induced to leave the nest, and will sit there in spite of shouts and stones, provided that the missiles do not actually strike the nest. A well-aimed stone will generally alarm

the cunning little animal, and cause it to make one of its rapid rushes to the top of the tree. The materials of the Squirrel's cage are very similar to those of an ordinary bird's nest, consisting of twigs, leaves, moss, and other vegetable substances. Its structure is tolerably compact, though it will not endure rough handling without being injured.

In this aerial nest the young squirrels are born, making their appearance in the middle of summer, and remaining with their mother until the following spring. There are generally three or four young; and though the nest appears to be so slight, it is capable of sustaining the united weight of young and parents. The Squirrel does not seem to make more nests than can be avoided, and, like many nest-builders, inhabits the same domicile year after year, until it is quite unfit for occupation. Should the nest be assailed while the young are still helpless, the mother takes them in her mouth one by one, leaps away with them, and deposits them in some place of safety. The materials of which the nest are made are grass, moss, and leaves, together with a few twigs, and the shape is nearly spherical. The winter cage, however, is most irregular in form, being accommodated to the space between the boughs in which it is built, and is very thick and warm.

The amount of materials collected for this purpose is surprising. All of them are large and thick-walled, but in some, which are probably old nests, with the accumulation of years upon them, the mass of dried vegetable substances is almost incredible. I have looked into many a winter cage, and on one occasion, when the nest was so hidden that those below could hardly see it, I pulled out whole armfuls of moss, leaves, and grass, and threw them to the ground, where they made a heap like a haystack. The spectators said it looked like the conjuror's trick of producing shawls, flowers, and goblets out of an empty hat. The nest had been deserted for some time, and all the materials were matted together by repeated rains.

## CHAPTER II.

*PENSILE BIRDS.*

**WEAVER BIRDS** and their general habits—**RED-BILLED WEAVER BIRD**—Its bovine friends—Its use to the buffalo—Other parasitic birds—The **SPOTTED-BACKED WEAVER BIRD**—Its nest, and variable method of construction—The **MAHALI WEAVER BIRD**—Shape of the nest—Singular defence—Theories respecting the structure—Habits of the bird—Remarkable nests of Weavers—Account of Weavers engaged in nest-building—Very curious contrivance—The **GOLD-CAPPED WEAVER**—Structure and situation of the nest—The **T'AHA WEAVER BIRD**—Locality selected for its nest—Destructiveness to crops—The **PALM SWIFT**—Its general habits—The nest and its variable structure—Silk-cotton—The **TAILOR BIRD**—Antiquity of handicrafts—Structure of the nest—The **FAN-TAILED WARBLER**—Singular method of fixing its nest—The **PENDULINE TITMOUSE**—Its habits and food—Remarkable nest and its form.

ALTHOUGH the majority of nest-making birds may be called Weavers, there is one family to which the name is *par excellence* and with justice applied. These are the remarkable birds which are grouped together under the name of Ploceidæ, all being inhabitants of the hot portions of the old world, such as Asia and Africa. The last-mentioned continent is peculiarly rich in Weaver Birds, as may be seen from a glance at the plate which accompanies this description,\* on which are shown a number of species, together with their nests.

For the most part, the Weaver Birds suspend their nests to the ends of twigs, small branches, drooping parasites, palm-leaves, or reeds, and many species always hang their nests over water, and at no very great height above

\* Frontispiece.

its surface. The object of this curious locality is evidently that the eggs and young should be saved from the innumerable monkeys that swarm in the forests, and whose filching paws would rob many a poor bird of its young brood. As, however, the branches are very slender, the weight of the monkey, however small the animal may be, is more than sufficient to immerse the would-be thief in the water, and so to put a stop to his marauding propensities. It is well known that the monkey race are very fond of a little bird, mouse, or egg, and that they have such a predilection for blood, that they will snatch the feathers out of parrots' tails, in order to suck the raw and bleeding quills.

Snakes, too, also inveterate nest-robbers, some of them living almost exclusively on young birds and eggs, are effectually debarred from entering the nests, so that the parent birds need not trouble themselves about either foe. Although they may repose in perfect safety, undismayed by the approach of either snake or monkey, they never can see one of their enemies without scolding at it, screaming hoarsely, shooting close to its body, and, if possible, indulging in a passing peck. Such a scene is depicted in the illustration,\* where Weaver Birds of several species have united in their attacks upon a monkey that is endeavouring to rob a nest, and has met with a suitable fate.

We will now proceed to examine the several species, together with their nests and general habits.

Our first example of the African Weavers is the RED-BILLED WEAVER BIRD, one of the most plentiful of its kind. It is remarkable for attending the buffaloes wherever they go. Should the buffalo be driven from any locality, as is often the case when civilisation begins to make its mark on a country, the Red-billed Weaver Bird also disappears, and is only to be found in those parts of the land where its huge associate can live in security.

The reason for this peculiarity is, that the bird finds the

\* Frontispiece.

greater part of its food upon the buffalo, catching and devouring the various parasites and insects which always accompany these animals. Wherever the buffalo exists, there the Weaver Bird may be seen, flitting about the animal as unconcernedly as if it were carved out of wood, perching on its head and pecking among the hair, settling on the massive horns and leaping at passing flies, while ever and anon it makes a dash along the back, digs away at the thick hide, and presently sits quietly on the buffalo, eating something which it has just secured.

The buffalo has very good reason to encourage the presence of its feathered allies, for not only do they free it from the troublesome insects, but they are always vigilant, and serve to detect danger. As soon as the bird perceives, or fancies that it perceives, anything that is suspicious, it ceases from feeding, and looks anxiously about. Should its suspicions prove correct, the bird flies in the air with the peculiar whirring sound that is indicative of danger, and which is known to the buffalo as well as to itself. As soon as the signal of danger is thus given, the buffalo dashes away into the thickest underwood, accompanied by its faithful friends. The reader must not suppose that every buffalo has its bird, or that even a herd of buffaloes must necessarily be accompanied by the Weavers. Sometimes a large party of buffaloes may be without a single bird; only where buffaloes do not exist, these Weavers are not to be found.

There are several other birds which are in the habit of attaching themselves to animals, such as the well-known zig-zac, which befriends the crocodile, the beef-eater, which perches upon the rhinoceros, and a congener, which is found upon the buffalo. This last bird, however, pays more attention to the "wurbles," or larvae of the bot-flies, which burrow into the skin, and make such ugly holes in the hide. All these birds feed upon the parasites and other creatures that are found upon the

animal which they affect ; and in every case they become watchful guardians, their own alarm being communicated to the larger animal.

Towards the upper part of the illustration may be seen a number of roundish nests, hung on branches in several rows. These are built by the SPOTTED-BACKED WEAVER BIRD, and are slightly variable in the method of their construction, some having the entrance nearly at the bottom, and others more towards the sides. They are all, however, constructed of similar materials, and the different position of the mouth is evidently intended merely as an accommodation to circumstances. Their eggs are not numerous, seldom exceeding four, and their colour is delicate green, something like those of our common starling. The bird is not very plentiful, and seems to be rather limited, in its range not appearing westward of the district called Kaffir-land. It is sometimes called the Yellow-crowned Weaver Bird.

All the pensile birds are remarkable for the eccentricity of shape and design which marks their nests ; although they agree in one point, namely, that they dangle at the end of twigs, and dance about merrily at every breeze. Some of them are very long, others are very short ; some have their entrance at the side, others from below, and others, again, from near the top. Some are hung, hammock-like, from one twig to another ; others are suspended to the extremity of the twig itself ; while others, that are built in the palms, which have no true branches, and no twigs at all, are fastened to the extremities of the leaves. Some are made of various fibres, and others of the coarsest grass-straws ; some are so loose in their texture that the eggs can be plainly seen through them ; while others are so strong and thick that they almost look as if they were made by a professional thatcher.

A good example of the last-mentioned description of

nest is the MAHALI WEAVER-BIRD of South Africa. Although the architect is a small bird, measuring only six inches in total length, the nest which it makes is of considerable size, and is formed of substances so stout, that, when the edifice and the builder are compared together, the strength of the bird seems quite inadequate to the management of such materials.

The general shape of the nest is not unlike that of a Florence oil-flask, supposing the neck to be shortened and widened, the body to be lengthened, and the whole flask to be enlarged to treble its dimensions. Instead, however, of being smooth on the exterior, like the flask, it is intentionally made as rough as possible. The ends of all the grass-stalks, which are of very great thickness, project outwards, and point towards the mouth of the nest, which hangs downwards; so that they serve as eaves whereby the rain is thrown off the nest, and possibly serve also as a protection against foes, though the latter theory has not yet been corroborated by observation.

It is true that the grass-stems protrude from the nest like "quills upon the fretful porcupine;" but that they really afford any obstacle to the attacks of a snake or a monkey I cannot believe. If the snake were able to get at the nest at all, it could glide into the aperture, with an upward curve of the flexible body, without troubling itself about the spikes; and if a monkey were to reach the nest, it seems to me that the projecting grass-stems would rather assist than deter it from taking the eggs, as one hand could steady the nest by holding the spikes, while the other was thrust into the aperture. Other nests, moreover, though exposed to the same enemies, and even when placed upon the same trees, do not possess this remarkable armature; and it is hardly to be supposed that if this abattis-like exterior were absolutely needful in the defence of the inmates, it would not be given to all the birds which build under similar conditions. The same may be said of the nests of the Pyrgitae. There are many structures

among animal habitations the use of which seems to be problematical; and until the case in point be decided by observation, it must remain an open question.

Dr. Smith remarks that the nests of certain Pyrgitæ—*i.e.*, little birds which are popularly called sparrows in South Africa—are armed in a similar manner, but with sticks and twigs, instead of grass.

The Mahali is a very sociable bird, being seldom seen alone, and usually assembling in flocks, which sometimes congregate on the ground, and at others assemble in the branches. It is equally sociable in the disposition of its nests, twenty or thirty of these curious structures being often found gathered closely together on the branches of a single tree. Although its colours are not brilliant, it is a pretty bird, the back being of that peculiar brown which is called “liver” by dog-fanciers, and the under parts white, a long patch of snowy white also passing over each cheek. It is about as large as our common starling, the total length being rather more than six inches.

Perhaps the most singular-looking nest made by these birds is that of a rather small, yellow-coloured species, a figure of which may be seen in the left-hand lower corner of the illustration. This nest looks very like a chemist’s retort, with the bulb upwards—or, to speak more familiarly, like a very large horse-pistol suspended by the butt. The substance of which it is made is a very narrow, stiff, and elastic grass, scarcely larger than the ordinary twine used for tying up small parcels, and interwoven with a skill that seems far beyond the capabilities of a mere bird.

The following account of Weaver Birds engaged in nest-making has been forwarded to me by Captain Drayson, R.A., who has frequently watched the whole proceedings:—

“The bird that builds these nests is colonially termed the Yellow Oriole. The ingenious little creature is nearly as large as a thrush, and is of a bright yellow colour, except the ends of the wings, which are of a brownish

hue. It is gregarious; and when a good locality has been found, several hundred nests will be suspended from some dozen trees, within a few yards of each other. The most pliant branches are invariably selected, from which the nest is suspended; and in all cases the end of the nest overhangs the stream, so that any additional weight would bring the nest into the water.

"The birds make a great disturbance when building, there being usually a regular fight in order to secure the best places. In building, the birds first commence by working some stout flags or reeds from the branch, so as to hang downwards. They then attach the upper part of the nest to the branch, so as to form the dome-like roof. By degrees they complete the globular bulb, still working downwards, and, lastly, the neck is attached to the body of the nest. Great skill is required to keep the neck even and open, and yet no machine could accomplish the work better than do these ingenious little architects. The upper part of the nest is very thick and firmly built, more than twice as thick as the neck, and the material of which it is made is far stronger. In some instances I have seen one nest attached to another; and when this is the case, the second builder strengthens the first nest, and then attaches his own work thereto.

"Should by chance a hawk or monkey venture into the vicinity of a colony of birds, it is chased and chirped at by hundreds of these little creatures, who make common cause against the intruder, and quickly drive him off. During the building of the nests, the river side is a most interesting place, as the intelligence and diligence of the birds are most remarkable."

If the hand be carefully introduced up the neck of one of these nests, its admirable fitness for the nurture of the young birds is at once perceived. When merely viewed from the outside, the nest looks as if it would be a very unsafe cradle, and would permit the young birds to fall through the neck into the water. A section of the nest,

however, shows that no habitation can be safer, and even the hand can detect the wonderfully ingenious manner in which the interior is constructed. Just where the neck is united to the bulb, a kind of wall or partition is made, about two inches in height, which runs completely across the bulb, and effectually prevents the young birds from falling into the neck.

Although the nests are seen in considerable numbers, the feathered architect does not seem to be a particularly sociable bird, seldom being seen in flocks, and, as a general fact, the male and female associate together and keep all other birds at a distance. The eggs are generally three in number, very pale blue with a few brownish spots, the spots being chiefly gathered towards the larger end. The parent birds are very assiduous in their household cares, and each sits alternately until the eggs are hatched. So absorbed are they in their task that they can be captured alive, merely by grasping the lower end of the neck with one hand, and then cautiously introducing the other hand into the nest. Perhaps this want of caution may arise from the nature of the nest, and the birds being free from all ordinary danger; and if the nest had been open, like that of most birds, the inhabitants would probably be as timid as is usually the case with birds when disturbed in their nests.

Below the first-mentioned nest, and nearly in the lower centre of the illustration, may be seen the beautiful nest of the GOLD-CAPPED WEAVER BIRD, the figure being drawn from a specimen in my own collection. The nest of this bird is notable for the extreme neatness and compactness of its structure, for it can endure a vast amount of careless handling, and still retain its beautiful contour. The nest was taken from the banks of a river near Natal, and was suspended from two reeds, so as to hang over the water, and at no great distance from the surface.

The whole structure is apparently composed of the same

plant, namely, a kind of small reed, but the materials are taken from a different portion of the plant, according to the part of the nest for which they are required. The whole exterior, as well as the walls, are made of the reed-stems, woven very closely together, and being of no trifling thickness. There is a considerable amount of elasticity in the structure, and the whole nest is so strong that it might be kicked down stairs, or be thrown from the top of the Monument, without much apparent deterioration. The interior, however, is constructed after a very different fashion. Instead of the rough, strong workmanship of the exterior, with its reed-stems interlacing among each other, as if woven by human art, and its pale yellow hue, the inside exhibits a lining of flat leaves, laid artistically over each other so as to form a soft, smooth resting-place, but not interlacing at all, being held in their place by their own elasticity. Their colour is of a pale bluish grey, and the contrast which they present to the exterior is very strongly marked. In size the nest is about as large as an ordinary cocoa-nut—not quite so long, though broader.

Mr. Swainson mentions that in one specimen of the nest made by this bird there was a peculiarity about the opening. "The aperture is lateral, but not upon the top, so that it serves the purpose of a window to the inmates, who are sheltered overhead by the convex top of the nest. There is something very ingenious in the construction of this opening, which is not, as it at first appears, round, but semicircular, the arch being bound round with a stronger band than usual, and the plane or base much stronger, and composed of straight pieces of the stalks of the grass, evidently for the purpose of giving to that part on which the birds perched greater strength and substance."

In the right-hand lower corner of the illustration is a nest of another species of Weaver Bird, the pretty TAHA WEAVER.

This species, though plentiful, is rather limited in range, and, according to Dr. Smith, is not seen southwards of lat. 26°. Northwards of that line, however, it was found in numbers, associating in large flocks, and generally haunting the neighbourhood of rivers. In some places, the trees that grew near the rivers were filled with crowds of the Taha Weaver Bird. In some localities, where the ground is cultivated, the Taha Weaver is more plentiful than is liked by the natives, for it is very destructive among the gardens; and, in places where it is very numerous, a continual watch must be kept lest the crop should be utterly destroyed.

Although the Taha Weavers are mostly found among trees, at the commencement of the breeding season they leave the branches, and retire to the reeds that fringe the river sides, and upon these reeds they build their pensile nest. The plumage of the Taha Weaver varies greatly according to the season of the year, the yellow of the summer coat being freely interspersed with brown dashes in the winter. Even the beak is said to change its colour, and to be lighter in the summer than in the winter.

As in the illustration of African Weaver Birds so many nests and their architects are introduced, I will give a brief summary of its contents.

In the right-hand upper corner are seen the curious nests of the Mahali Weaver, accompanied by the birds themselves. Just below the Mahali are several rows of nests pendent from boughs. These are the homes of the Spotted Weaver, and are represented as attacked by monkeys, which are being ducked for their pains, and will not succeed in reaching the nests. The monkey is the vervet, commonly called the green monkey, and is of the species that so frequently accompany organ-grinders in this country. Assailing and bickering at the monkeys are several other species of Weavers. Some of the Spotted Weavers are defending their homes, and are aided by

three other species, one known by its lighter hue, another distinguished by its dark bill, and a third known by its light bill.

Rather in the background, and in the centre, are some nests of *Ploceus Capensis*, woven with a palm-leaf. In the left-hand lower corner is the long, retort-shaped nest of the pretty Yellow Weaver; in the corresponding right corner is the Taha Weaver; and hanging over the water at the bottom of the illustration is the habitation of the Yellow-capped Weaver.

In Jamaica there is a bird, which would not allow any illustration of its size and beauty, but is nevertheless a most interesting species. This is the PALM SWIFT, easily known by the broad white belt on its black body, something like the white band on the common house martin.

As is implied by its generic name, the Palm Swift is celebrated for its very great speed, which it exhibits by its darting flight over the grass savannahs. As, moreover, it resides in Jamaica throughout the whole year, it gives every opportunity for observing its habits.

The nest of this bird is very curious, and always pensile; and, though it can never be mistaken for that of any other bird, it is built after a very diverse fashion. Usually it is fastened to the spathe of the common cocoa-nut palm, being cemented to the leaf so firmly, that if it be pulled away by force, the outside integument of the leaf comes away also. The nest is ingeniously hidden in the leaf, so that it would not be noticed by an ordinary observer, were it not that in some cases the bird is so very liberal of its materials that their superabundance betrays its presence. The nest is made of cotton and feathers, the cotton forming the exterior and the feathers the lining. The walls of the nest are very strong, though flexible, and something like felt, being firmly compacted, and containing an enormous mass of downy feathers, in the middle of which the eggs are laid.

The cotton is of a very short staple, and is not the substance used in commerce, but the produce of the silk-cotton trees belonging to the genus *Bombax*. These trees are of very great size, the trunks running nearly a hundred feet in height, without a branch, and being even more than proportionately thick. The cotton is of very trifling use in commerce, the staple being not much more than an inch in length, and is chiefly employed for stuffing mattresses and pillows. The native tribes of Guiana use it for the tiny arrows which they project through their long and slender air-guns, fastening it upon the head of the arrows so as to make them fit the tube. A quantity of this cotton is now before me, and it is evident that the very qualities which render it useless for commercial or mechanical purposes are precisely those which are best adapted for the structure of the nest. It is remarkably fine in texture, being almost silky to the touch; and, instead of becoming inextricably entangled, as is the case with ordinary cotton-wool, it cannot be handled without leaving a number of short fibres on the fingers. Its usual colour is yellowish, but occasionally it is nearly white.

Several nests are often found in each spathe; and it is a curious fact that, in such cases, they are agglutinated together with the same substance that fastens them so firmly to the leaf, and are connected by a kind of gallery, which runs along the side, and communicates with each nest. It is thought that the bird occupies the same nest repeatedly, after the manner of swallows and martins, and that it does not desert the tenement until the spathe becomes detached and falls to the ground, after the custom of its kind. Fallen spathes are plentiful under the palms, and in them the nests of the Palm Swift are frequently seen.

Sometimes the Palm Swift chooses another tree, and builds its nest in the palmetto, a palm belonging to the genus *Chamaerops*. In such cases, the nest is of a different

shape to that which is found in the cocoa-palm, something resembling in form the indiarubber tobacco-pouches which are now so common. The exterior of the nest is loose and woolly, instead of being firm and compact ; and in some instances it is so very loose, that it looks just like a doll's wig. The eggs of the Palm Swift are white.

The man who first invented sewing in all probability thought that he had discovered, or rather created, an art which was entirely new, and that to him alone was due the credit of perceiving the virtues of a fibre thrust through holes.

The capabilities of his invention he could not be expected to foresee, inasmuch as he would in all probability limit its powers to the decoration rather than the clothing of his own person. In process of time he might comprehend that, by means of the needle and thread, a number of small leaves or skins might be made to serve the same purpose as a single large one, and as his instruments improved, so would his work. There are, it is true, certain nations who have been acquainted with the art of sewing from time immemorial, and never seem to have made the least progress in it. The native Australian, for example, displays wonderful ingenuity in making thread from the sinews of the kangaroo's tail, and needles from the emu's bones ; but there his invention seems to have stopped, and up to the present time, the junction of a couple of kangaroo skins, or the sewing together of a few "opossum" furs, seem to be the limits of his powers. Still, in other countries, the needle and thread have, as a rule, exhibited a regular improvement, until they have culminated in the sewing-machine of the present day. Had, however, some good genius enabled the original founder of the art to foresee its effect upon the world, he might well have been proud of his discovery, the earliest of human arts.

The respectable guild of tailors, indeed, were wont to attribute to their mystery an antiquity surpassing that

of any other handicraft, and, on the strength of a certain passage in Genesis, claimed Adam as the first tailor. As to the smiths and musicians, the tailors looked down upon them as of comparatively recent origin, and considered even the mysterious order of Freemasons as modern upstarts. Had they been moderately skilled in ornithology, they might have claimed a still older origin, on the grounds that, long before man came on the earth, the needle and the thread were used for sewing two objects together.

The wonderful little bird, whose portrait is accurately given in the accompanying illustration, is popularly known by the appropriate title of TAILOR BIRD. The manner in which it constructs its pensile nest is very singular. Choosing a convenient leaf, generally one which hangs from the end of a slender twig, it pierces a row of holes along each edge, using its beak in the same manner that a shoemaker uses his awl, the two instruments being very similar to each other in shape, though not in material. These holes are not at all regular, and in some cases there are so many of them, that the bird seems to have found some special gratification in making them, just as a boy who has a new knife makes havoc on every piece of wood which he can obtain.

When the holes are completed, the bird next procures its thread, which is a long fibre of some plant, generally much longer than is needed for the task which it performs. Having found its thread, the feathered tailor begins to pass it through the holes, drawing the sides of the leaf towards each other, so as to form a kind of hollow cone, the point downwards. Generally a single leaf is used for this purpose, but whenever the bird cannot find one that is sufficiently large, it sews two together, or even fetches another leaf and fastens it with the fibre. Within the hollow thus formed the bird next deposits a quantity of soft white down, like short cotton wool, and thus constructs a warm, light, and elegant nest, which is scarcely

visible among the leafage of the tree, and which is safe from almost every foe except man.

There are several nests of the Tailor Bird in the British Museum, one composed of several leaves, and the other in which one leaf is used. It is a pity that in all instances



THE TAILOR BIRDS

the leaf has been plucked from the twig on which it grew, and it is to be wished that when other specimens are brought to England the twig will be cut off, and that if the leaf should fall off, it may be replaced on the spot whereon it grew. Beautiful as is the detached nest, it

does not give nearly so vivid an idea of its object as if it were still suspended to its branch.

The Tailor Bird is a native of India, and is tolerably familiar, haunting the habitations of man, and being often seen in the gardens and compounds, feeding away in conscious security. It seems to care little about lofty situations, and mostly prefers the ground, or lower branches of the trees, and flies to and fro with a peculiar undulating flight. Many species of the same genus are known to ornithologists.

The tailor bird is not the only member of the feathered tribe which sews leaves together in order to form a locality for its nest. A rather pretty bird, the FAN-TAILED WARBLER, has a similar method of action, though the nest cannot be ranked among the pensiles.

This bird builds among reeds, sewing together a number of their flat blades in order to make a hollow wherein its nest may be hidden; but the method which it employs is not precisely the same as that which is used by the tailor bird. Instead of passing its thread continuously through the holes, and thus sewing the leaves together, it has a great number of threads, and makes a knot at the end of each, in order to prevent it from being pulled through the hole. A description and beautiful figure of this bird may be seen in Gould's "Birds of Europe," vol. ii.

The odd little titmice can be admitted among the Pensile Birds, as one of them constructs a habitation as purely pensile as any which has yet been mentioned, and which yields in beauty to none. This is the PENDULINE TITMOUSE, a native of Southern and Eastern Europe. As is the case with all its family, it is a little bird, scarcely exceeding four inches in length, and being marked with pleasing though not very brilliant colours. In general habits it resembles the bearded titmouse of England,

haunting the sides of streams, and feeding upon the seeds of aquatic plants, as well as upon the various insects, larvæ, and small molluscs that are found so plentifully in the water.

The chief point of interest in this bird is, however, concentrated in its nest, which is made in a flask-like shape, and is mostly suspended to the extremity of some twig that overhangs the water. Willows, and other trees that are fond of the water, are favoured residences of this curious little bird. The larger end of the nest hangs downwards, so that at a little distance it looks like a huge pear with a rather long stem. The material of the nest is the cottony down of the willow and poplar, and the opening is always at the side. The position chosen is not invariably at the end of a twig, as the nest is sometimes found among the reeds, hidden by their thick stems from observation.

## CHAPTER III

*PENSILE BIRDS (Continued)*

Australian Pensiles—The YELLOW-THROATED SERICORNIS—Its habits—Singular position for its nest—Conscious security—The Rock WARBLER—Shape and locality of its nest—The YELLOW-TAILED ACANTHIZA—Its colour and song—Supplementary nests—The PINCING and its home—Supposed use of the supplementary nest—The SINGING HONEY-EATER and its nest—The Myall or Weeping Acacia—Various materials—The LUNULATED HONEY-EATER—A new material—The PAINTED HONEY-EATER—Its habits and nest—The art of preservation—Nests and their branches—The colour of eggs—The WHITE-THROATED HONEY-EATER and its habits—Its curious nest—Locality of the nest—The GOLDEN-CRESTED WREN, and the resemblance of its nest to those of the Honey-Eater—The SWALLOW DICÆUM—Its song and beauty of its plumage—The nest, its materials, form, and position—The HAMMOCK BIRD—Singular method of suspending the nest—The WHITE-SHAFTED FANTAIL—Strange form of the nest—The appendage or tail of the nest.

SOME very remarkable instances of pensile birds' nests are found in Australia, and for many of them we are indebted to the patient and careful research of Mr. J. Gould, from whose skilful works on ornithology several illustrations have been, by permission, copied.

A very curious instance is found in the nest of the YELLOW-THROATED SERICORNIS, a rather pretty, but not a striking bird. The general colour is simple brown, and, as its name imparts, the throat is of a citron-yellow. The only remarkable point in the colour, beside the yellow

throat, is a rather large patch of black, which envelops the eye and passes down each side of the neck, nearly as



SINGING HONEY-EATER  
PAINTED HONEY-EATER.  
YELLOW-THROATED SERICORNIS

PAINTED HONEY-EATER.

WHITE-THROATED HONEY EATER.  
ROCK WARBLER.

far as the shoulders. It is the largest of its genus, and, although not rare, is seldom seen except by those who

know where to look for it, as it is scarcely ever observed on the wing, but remains among the thick underwood, flitting occasionally between the branches, but mostly remaining on the ground, where it pecks about in search of the insects on which it feeds.

The reason for its mention in this work is the singular structure of its nest, which is described by Mr. Gould in the following words:—

“One of the most interesting points connected with the history of this species is the situation chosen for its nest.

“All those who have rambled in the Australian forests must have observed that, in their more dense and humid parts, an atmosphere peculiarly adapted for the rapid and abundant growth of mosses of various kinds is generated, and that these mosses not only grow upon the trunks of decayed trees, but are often accumulated in large masses at the extremities of the drooping branches. These masses often become of sufficient size to admit of the bird constructing a nest in the centre of them, with so much art that it is impossible to distinguish it from any of the other pendulous masses in the vicinity. These bunches are frequently a yard in length, and in some places hang so near the ground as to strike the head of the explorer during his rambles; in others, they are placed high up on the trees, but only in such parts of the forest where there is an open space entirely shaded by overhanging foliage. As will be readily conceived, in whatever situations they are met with, they at all times form a remarkable and conspicuous feature in the landscape.

“Although the nest is constantly disturbed by the wind, and liable to be shaken when the tree is disturbed, so secure does the inmate consider itself from danger or intrusion of any kind, that I have frequently captured the female while sitting on her eggs, a feat that may always be accomplished by carefully placing the hand over the entrance—that is, if it can be detected, to effect which, no slight degree of close prying and examination is necessary.

"The nest is formed of the inner bark of trees, intermingled with green moss, which soon vegetates; sometimes dried grasses and fibrous roots form part of the materials of which it is composed, and it is warmly lined with feathers. The eggs, which are three in number, and much elongated in form, vary considerably in colour, the most constant tint being a clove-brown, freckled over the end with dark umber-brown, frequently assuming the form of a complete band or zone; their medium length is one inch, and their breadth eight lines."

If the reader will bear in mind the remarkable shape of this and a few other nests, he will see, in a future page, how wonderful is the resemblance between the pensile nests of birds and insects.

Pensile birds do not always suspend their nests to the branches of trees, but in some instances choose exactly the localities which appear to be the most unsuited for the purpose. Still keeping to Australia, we may find a most wonderful example of a pensile nest near mountain courses. The bird which makes it is called, indifferently, the Rock WARBLER, or the CATARACT BIRD, because it is always found where water-courses rush through rocky ground. So attached is the bird to these localities, that it is never seen in the forest, nor ever has been observed to perch upon a branch. The generic name, *Origma*, is derived from a Greek word, signifying a rock or a precipice, and is more appropriate than are many scientific titles.

It is a small bird, no larger than our sparrow, and is soberly coloured, the general hue being brown, relieved by a dull red on the breast, something like that of the female robin. It has a melodious though not very powerful note; but its chief claims to admiration are founded upon the extraordinary nest which it builds. In general shape this nest somewhat resembles a claret jug without a handle, having a long, slender neck and a globular and suddenly-rounded bulb.

It is suspended from the rocks in sheltered places, and wherever an overhanging ledge of rock affords protection from the elements, there the strange nests may be found. Just as the martins take a fancy to some favoured spot, and build whole rows of nests on one side of some particular house, utterly disdaining neighbouring houses, which, to all appearance, afford exactly the same advantages, so do the Rock Warblers affect some particular rock, and hang their nests by dozens in close proximity to each other. The material of the nest is the long moss which is plentiful in the country ; and, as may be seen from the illustration, the entrance is near the centre of the rounded bulb. In consequence of the material of which the nest is constructed, it is very rough on the exterior, though smooth and comfortable enough within.

Australia certainly produces some of the most singular objects in the world. Among the many varieties of birds' nests which are found in this region, there is one of a very curious form, resembling very greatly a common cottage loaf, and being in fact a double nest, one being placed upon the other.

The bird which makes this nest is termed the YELLOW-TAILED ACANTHIZA, and is not uncommon in different parts of Australasia. It is rather a neat-looking bird, the colours being beautifully blended together. The back and upper parts are greenish, like the hue of our common wood-wren, and below it is pale yellow, while there is a patch of bright golden yellow at the base of the tail. As if to contradict the popular idea that the birds of Australia have no song, the Yellow-tailed Acanthiza sings a bright, cheerful note, very like that of the goldfinch, so that it is in all points a pleasing little bird.

It is seldom seen on the wing, or, at all events, seldom flies to any distance, as it prefers to remain on the ground, or in the bush, and when disturbed will fly for a few yards and then settle again. It is generally found in small

flocks, consisting of six or ten in number, and as it is by no means timid, will allow itself to be approached closely before it takes alarm.

The nest is a very remarkable structure. In most cases it is formed as has just been mentioned, a little nest being stuck on the large one. The materials of which it is made are grass, wood, and leaves, and the structure is rather loose and careless. Generally it is suspended from the delicate mimosa branches, especially in Van Diemen's Land; but when it builds in gardens, as is often the case, it mostly prefers a low shrub for that purpose. Unfortunately for the bird, the bronze cuckoo has a predilection for its nest, and lays its eggs therein. Whenever this is the case, the parasitic bird takes entire possession of the nest, and no other young are found in it.

The supplementary nest is not invariably present, and both the size and shape are extremely variable. The reader may perhaps remember that the PINC-PINC of Africa has a similar custom, constructing a supplementary roosting-place upon the nest. The home of the Pinc-pinc is of much firmer structure than that of the Yellow-tailed Acanthiza, being made of vegetable fibres, interwoven so strongly and elaborately that a thick, felt-like substance is produced. The entrance to the nest is formed in a tubular shape, and projects for an inch or two, so as to look like a spout, and near the entrance is constructed a rounded projection on which a bird can repose.

Some persons think that the male bird uses this perch, and that he posts himself by the entrance in order to act as a sentry and to keep guard over the inmates. It is more probable, however, that the projection is used, not so much as a resting-place for the male, although he may possibly take a fancy for sitting in the fresh air rather than in the nest, as a perch on which the bird can settle before it passes into the tubular entrance. This supposition is borne out by the fact that there are mostly several of these perches on each nest, so that the whole

structure assumes a rather awkward and irregular aspect. The nest is of very large dimensions when compared with its architect, being on the average four inches in diameter.

There is another species of *Acanthiza* which lives in Australia, and builds a nest very similar in its materials and the general principle of its structure to that of the bird already described, except that the supplementary nest is not present.

A most beautiful pensile nest is made by the SINGING HONEY-EATER, a species which is spread over a large portion of Australasia.

Here we have another example of an Australian singing bird, for the melody of this creature is so loud, so full, and so rich in tone, that Mr. Gould compares it to that of the missel thrush. It is a soberly-coloured bird, though easily identified, the back being pale brown, the top of the head yellow, and a deep black patch passing over the eye and turning downwards along the side of the neck. It is a lively bird, as are all those feathered creatures which feed chiefly on insects, and even in mid-winter its melodious song may be heard in full vigour.

There is a very common tree in Australia, popularly called the myall, known to scientific botanists as *Acacia pendula*. The twigs of this tree are long and very slender, and the leaves are so narrow and delicate that at a little distance they look more like grass-blades than the leaf of a tree. The reader may remember that this is a characteristic of all drooping or "weeping" trees, the leaf and the twig being slender in proportion to each other. The weeping birch and the weeping willow of our own country are good examples of this peculiarity.

Thus, as both the leaves and the twigs of the myall are extraordinarily long and slender, the tree is chosen by many birds which build pensile nests, as will be seen in the course of this volume. It seems a tree that was made for the express purpose, because the long and slender

twigs serve the double purpose of affording a firm attachment for the nest and suspending it where no ordinary foe can reach it, while the delicate leaves give their aid in fastening the nest to the twigs, and at the same time serve to conceal the structure from prying eyes.

Although the general structure of the nest is the same in all parts of the country, the materials necessarily differ. In New South Wales, the external shell of the nest is formed of very fine dry stalks, not thicker than twine, while the lining is composed of fibrous roots, matted together with spiders' webs. It is fastened by the rim to the twigs, and as a few of the slender twigs occasionally are interwoven into the nest, it hangs quite securely. In Western Australia, the nest is made of grasses, which, although green when first woven, become white and dry in a short time. The grass is mingled with the hair of the kangaroo, and the fur of some phalangist, vulgarly called opossum, which serve to mat the grass together and to make it impervious to the wind and rain; and the interior is neatly lined with grasses and vegetable down.

There are many Honey-Eaters in Australia, all of which are easily known by the hairy tuft at the end of the long tongue, which is used for licking the sweet juices out of flowers. The entomological reader may perhaps remember that the tongue of the hive bee is constructed on precisely the same principle, being long, slender, mobile, and fringed with hair at its top.

Many of them construct nests which may fairly be reckoned among the pensile, and one of the prettiest among the number is that which is built by the LUNULATED HONEY-EATER. The bird is easily recognised by the white crescentic mark which runs round the back of the neck, the horns pointing upwards towards the opening of the mouth, and forming a striking contrast with the black hue of the head and neck.

The nest of this bird is very like that of the Singing Honey-Eater, but is mostly suspended to the thinnest twigs which grow at the summit of the enormous Eucalypti trees. Owing to the great height at which it is placed, and the leaves which surround it, none but an experienced eye can detect it. The walls of the nest are ingeniously made of the inner rind or "liber" of the stringy-bark and other gum-trees, a material which is not unlike the "bass," with which all gardeners are so familiar. The hair of various animals is mixed with the bark, and since sheep have been introduced into Australia, the bird has always availed itself copiously of their wool, finding that it can be worked well into the nest, and serves to bind the materials firmly together. As the nest is always hung by the rim to the twigs, strength of substance is an absolute necessity, and the toughness of fibre and the felting property of the wool make it a most valuable addition to the building materials used by the bird.

For the lining of the nest, the Lunulated Honey-Eater retains the materials to which it has always been accustomed, and uses the fur of the phalangists, which has the advantage of being very soft, very warm, of retaining its elasticity, and of not adhering to the claws of the inmates, as would be the case with wool.

There is another of these pretty birds, called the PAINTED HONEY-EATER, on account of the variety of its colouring. The general colour of this handsome bird is rich brown above, with the exception of a yellow patch on the base of the tail, and white, slightly spotted, below. A characteristic mark of the species is a little patch of pure white just by the ears.

This handsome species inhabits the interior of New South Wales, and does not confine itself merely to a diet of sweet juices, but feeds much on small insects. The generic title, *Entomophila*, is composed of two Greek

words, which signify insect-lover, and is given to this bird, and several other Honey-Eaters, on account of their insect-eating habits. The birds are extremely active, and devote much of their time to the pursuit of insects on the wing, in which occupation they have a great resemblance to our well-known fly-catcher. They sit on a branch, keeping a careful watch, and whenever an insect passes near, they dart into the air, catch it, and return to their post. They are generally seen in pairs, and are very playful, chasing each other merrily, and spreading their tails so as to show the white colour. When on the wing, they are so like the common goldfinch that they might easily be mistaken for that bird, the patchy distribution of the colour, and the white spot on the face, adding greatly to the resemblance. The nest of this bird is a beautiful example of the pensiles, and on looking at a specimen it is impossible to restrain a feeling of regret that the art of preservation as it now stands will not permit us to retain the branch and its delicate leaves in all their lovely greenery, their long, spear-like blades affording so beautiful a contrast to the dry and withered substance of which the nest is made.

I may perhaps throw out a hint to collectors of birds' nests, that they would always increase the value of the nest by retaining as much as possible of the branch on which it was placed, as the interest greatly depends upon the precise relation which the nest bears to its locality. None, for example, can properly appreciate the extreme beauty of the nest built by the chaffinch, until they see the exquisite manner in which the exterior is covered with mosses and lichens, which exactly resemble in colour the bark of the branches amid which it rests. The pretty cup-like nest of the goldfinch, the domed structure of the long-tailed titmouse, the basin-shaped home of the thrush, and the clumsy structure of the rook, are all so beautifully adapted to the situation which they occupy, that to remove them from their surroundings is to deprive them of half their value.

Although the leaves cannot be induced to retain their form or colour, and always become crisp, and dry, and shrivelled, and brown, the branches still keep their form, and, if properly managed, may be made to retain their position. The best plan for restoring the nest to its original appearance is to substitute for the dried foliage a new set of artificial leaves, which are now made so true to nature that they can scarcely be distinguished from their living models. Only, it is to be hoped that the arsenical green will not be used, not only on account of its poisonous qualities, but also of its peculiar hue, which is quite unlike that of living leaves. The life-like appearance of the bark can easily be restored by the judicious use of colour, moistened wafers, and varnish.

The eggs, too, should always be made to appear in their natural hues, which in many instances are lost when the contents are removed. This is invariably the case with all of the smaller eggs where the shell is not deeply coloured ; and in some instances, such as the egg of the kingfisher, the swift, the dipper, and the sand-martin, the colour of the egg is changed from delicate pink to chalk-white. I always renew the colour of these eggs by injecting a mixture of carmine and gamboge—a single drop is sufficient for a small egg ; and in order to prevent it from drying in streaks and blots, I hold it over a spirit-lamp, or before a fire, and turn it continually until it is quite dry. An unblown egg should be kept as a model whereby the colour can be precisely determined ; and when it is properly done, the effect is very beautiful. A pure white egg, like that of the kingfisher, is much improved by heating the shell, after the colour is dry, and then injecting a little boiling wax, so as to back up the colour, and restore the beautiful translucence of the unblown egg. A tiny scrap of silver-paper should then be fastened over the orifice, in order to prevent dust from entering.

To return to our Honey-Eaters. The material of which the nest of the Painted Honey-Eater is composed is fine

fibrous roots, interwoven very artfully, but loosely, and being of so frail a structure, that much care is required to remove it without damage. It is fastened by the rim to the delicate twigs of the beautiful weeping acacia, whose long lanceolate leaves droop over and nearly cover it. It is a very small nest in proportion to the size of the bird.

Still keeping to the same interesting family of birds, we find among the pensile builders another species of Honey-Eater.

The WHITE-THROATED HONEY-EATER is rather like the Painted Honey-Eater, being brown above, white below, and having a yellow patch on the base of the tail. It is, however, easily distinguished from its congener by the peculiarity from which it derives its name—viz. a large patch of pure white in the front of the throat, extending as far as the eyes. The top of the head is greyish blue, and the breast is buff.

It is a lively, active little creature, ever on the move, and delighting to flit from branch to branch, but not caring to make long flights. As it flies from one bough to another, it utters a musical little song, much like that of the goldfinch, and continues to sing for a considerable time. It detests wind, and is mostly seen in the thick bush, and loves to frequent the masses of mangroves which edge bays and creeks, because the air is comparatively still. In these places may be found its curious nest, which is about as large as a breakfast-cup, and very much of the same shape. It is made of the delicate paper-like bark of the Melaleucae, and various vegetable fibres, with which it is ingeniously hung to the branches. The broad, thin bark causes it to be very smooth on the exterior. For the lining, the bird is not indebted to any animal or bird, but uses grass-blades, which are neatly laid, and form a soft resting-place for the eggs.

The nest is placed very low, being often found scarcely

two feet from the water, in that point resembling the nest of the African weaver birds, which have already been described. It is always hung near the extremity of a branch, and invariably is so placed as to be under the protection of a spray of leaves, which act as a roof whereby the rain is thrown off.

In order that these singular Australian nests which have been described may be compared with each other at a glance, five of the most remarkable examples have been placed in the same illustration, and by comparing the description with the figures, a better idea will be obtained than if each had formed the subject of a separate illustration.

Before proceeding to describe another remarkable pensile builder of Australia, I must draw the attention of the reader to a bird of our own country, which often builds a pensile nest, in some respects resembling that of the White-throated Honey-Eater. Want of space forbids me to introduce an illustration of this exquisite little creature, including a figure of its nest, which equals in beauty the home of many foreign birds. As, however, this nest is tolerably familiar, and examples can always be obtained, I have preferred to insert figures of the nests made by exotic and less-known birds.

The GOLDEN-CRESTED WREN, whose form and colours are so well known as to require no description, builds a beautifully neat little nest, thickly lined with feathers, in which the minute little nestlings can lie securely. The nest is always placed under the protection of a natural roof, a spray of leaves being a favourite spot. Almost invariably the nest is fairly suspended, and in several instances I have noticed that three branches were used for the purpose.

We will now return to our Australian birds.

There is a genus of very small birds, called *Dicæum*,

### *THE SWALLOW DICÆUM.*

which is spread over many parts of the world, and finds several representatives in Australia. All are interesting



*SWALLOW DICÆUM*

birds; but as the present work only treats of birds as the architects of their nests, it is necessary to select one which builds a pensile habitation. This is the SWALLOW DICÆUM,

a bird scarcely as large as our common wren, and glowing with brilliant colours, the whole of the upper part being deep, glossy blue-black ; the throat, breast, and under tail-coverts of a fiery scarlet ; and the abdomen pure white. It has a very sweet though low and inward note, so faint as scarcely to be audible from the tops of the trees, but continued for a long time together.

Artificial aids to vision are required in order to watch the habits of the *Dicæum*, for it loves the tops of the tallest trees, where its minute body can scarcely be seen without the assistance of glasses. The *Casuarinæ* are favourite trees with this bird, which is fond of flitting about the branches of a parasitic plant called *loranthus*, which bears viscid berries. It is not precisely known whether the bird haunts the *loranthus* for the sake of the berries or of the insects, but as the *Dicæum* is one of the insect eaters, the latter supposition is probably correct.

It is very seldom if ever seen on the ground, and its flight among the upper branches is quick, sharp, and darting.

The nest of the Swallow *Dicæum* is as pretty as its architect, and its ordinary shape can be seen in the foregoing illustration, though the plain black and white of a wood engraving can give but little idea of its full beauty. In colour it is nearly pure white, being made of the cotton-like down which accompanies and defends the seeds of many plants, and this material is so artfully woven that the nest almost looks as if it were made from a piece of very white cloth. It is always purse-like in form, though its shape is slightly variable, and is suspended by the upper portion to the twigs at the very summit of the tree. Generally it hangs its nest upon the parasitic plant which has already been mentioned, but it often selects the *Casuarinæ*, or the delicate twigs of the myall or weeping acacia, for that purpose. The average number of eggs is five, and their colour is greyish white, thickly powdered with small brown specks. Their length is about three

quarters of an inch, and their breadth rather less than half an inch.

In a previous page it has been mentioned that a bird was undoubtedly the first tailor, and used needle and



LANCEOLATE HONEY-EATER.

thread ages before man had invented such implements. We now come to a bird which may be accepted as the first hammock-maker, its nest being made of a hammock-like shape, and slung just as a seaman slings his oscillating couch. Scarcely any more comfortable bed could be invented, provided that it be properly suspended, and

the bird certainly deserves our gratitude, if it be only for the fact that it *might* have given the first hint on the subject.

It is one of the Honey-Eaters, and is called the LANCEOLATE HONEY-EATER on account of the shape of its feathers. It is not a brilliantly coloured bird, its hues being only brown and white, diversified by a black line down the middle of each feather. It does not seem to be a very lively bird, being accustomed to sit on the very top of some lofty tree, such as an acacia or eucalyptus, and to remain almost motionless in one spot. So still and quiet is it that it would hardly be seen, were not its presence betrayed by an occasional powerful and shrilly-sounding whistle. Its food consists partly of insects, and partly of the pollen and sweet juices of flowers.

The wonderful nest of this bird was found by Mr. Gould on the Liverpool Plains, overhanging a stream, and being a beautiful example of the pensiles. The materials of which it is made are grass and wool, intermingled with the pure white cotton of certain flowers. As the reader may see, by reference to the illustration, it is hung from a very slender twig, and only suspended at opposite extremities of the rim, the tree selected being the myall, or weeping acacia. The nest is rather small in proportion to the bird, and is very deep, so that when the mother is sitting on her eggs, or brooding over her young, she is obliged to pack herself away very carefully, her tail projecting at one side of the nest and her head at the other.

Our last example of the Australian pensile nests is one which is made by the WHITE-SHAFTED FANTAIL, a native of Van Diemen's Land and the southern and western portions of Australia. It is rather a pretty bird, being boldly marked with black and white, and is remarkable for the fact that the shafts and tips of the tail-feathers are pure white, the central feathers only excepted. It derives its popular name of Fantail from

its habit of spreading its tail like a fan while descending, and as the tail is very broad, the action has a really remarkable effect.

The nest of this bird is of a figure not very easy to describe, but an idea of it may be formed from a common wine-strainer, with a very long and straight spout. The nest is attached to a branch rather below the middle of the cup, so that the long spout hangs down like a tail, quite independent of the bough. What can be the object of this appendage no one knows, and there is no purpose that it can even be imagined to fulfil, except perhaps that it may serve as a conductor. Like many other pensile nests, it is placed at a low elevation, and hung over water. Sometimes, however, it is found in a forest where no stream runs, but even in such a case it is suspended not many feet from the ground, though high enough to guard it against the attacks of any ordinary foe.

The materials of which the nest is made are the delicate inner bark of the gum-tree, together with mosses, and the soft down obtained from the tree-fern. These substances are interwoven with tough spiders'-web, which has the effect of binding them firmly together. This remarkable nest is mentioned in the present place because its peculiar shape bears some resemblance to certain pensile nests formed by the humming birds, and which will presently be described.

The bird itself is a lively and amusing little being, not only active on the wing, but singularly bold and confiding in character, betraying little fear of man, and even entering houses when engaged in chasing insects. These attributes, however, entirely disappear during the breeding season, when the little bird becomes as shy, as suspicious, and as timid as it was formerly bold and confiding. It cannot endure that a human being should even approach its nest, and in order to draw off his attention, acts after the manner of the lapwing, and by feigning lameness endeavours to decoy the intruder in another direction.

The white-shafted Fantail rears at least two broods in a season, and has occasionally been known to produce a third. There are only two young in each brood, so that the parents are not subject to very hard work when rearing their offspring.

These birds are generally seen in pairs, but are not gregarious, and, as far as is known, they are permanent residents in Australia, merely shifting their quarters at the different seasons.

## CHAPTER IV.

*PENSILE BIRDS (Continued)*

American Pensile Birds—Humming Birds, and the general structure of their nests—The LITTLE HERMIT, its colour, habits, and nest—The GREY-THROATED HERMIT and its hardihood—The PYGMY HERMIT and its seed nest—The LONG-TAILED HUMMING BIRD—Mode of building its nest—The WHITE SIDED HILL STAR—Curious method of suspending its nest—The SAPPHO COMET—The CHIMBORAZIAN HILL STAR—Curious locality—Its habits, food, and nest—The SAWBILL and its singular nest—Habits of the Sawbill—The BRAZILIAN WOOD NYMPH—Use made of its plumage and its nest—The RUBY AND TOPAZ HUMMING BIRD—Stuffed Skins—The AZURE CEREBRA, its colour, nest, and habits—The BALTIMORE ORIOLE—Reason for its name—Its beautiful nest, and curious choice of materials—Familiarity of the Baltimore Oriole—The ORCHARD ORIOLE or BOB-O'LINK—Various forms of nest—Why called Orchard Oriole—The CRESTED CASSIQUE, its size, form, and colours—Its remarkable nest—Difficulty of obtaining nests—The GREAT CRESTED FLY CATCHER, and its use of serpent-sloughs—The RED-EYED FLYCATCHER, or WHIP-TAIL-KELLY—Low elevation of its nest—The WHITE EYED FLYCATCHER, its nest, and fondness for the prickly vine—The PRAIRIE WARBLER, its habits and nest—The PINE CREEPING WARBLER—The Asiatic pensiles—The BAYA SPARROW—Its colour and social habits—Singular form of the nest.

HAVING now taken a cursory glance at the pensile nests constructed by the feathered inhabitants of Africa and Australia, we again cross the sea and come to America. There are many pensile builders among American birds, and chief among them are the exquisite little creatures

called the HUMMING BIRDS, which are peculiar to America and her islands.

Among the multitudinous species of this wonderful group of birds are very many examples of pensile nests, that mode of structure being, indeed, the rule, and any other the exception. As is the case with the nests of the Australian birds, some are suspended from twigs, others from rocks, and others again from leaves, the last-mentioned plan being the most common. It is evident that, in order to enable a nest to be fastened to a leaf, some very tenacious substance must be employed; and this is found in the webs of various spiders, some of which are of wonderful strength and elasticity—as strong, indeed, as the silken lines of our well-known brown-tailed moth, which, though tightly stretched, can be pulled without breaking, and spring back to their former position like a harp-string. There is also a great variety in spiders' webs, so that the birds can procure at will the long elastic threads with which the materials of the nest can be tied together, or the soft felt-like substances with which the moss, bark, and fibres can be interwoven, so as to form a firm and wet-resisting mass.

Our first example of the pensile Humming Bird is the beautiful species called the LITTLE HERMIT, a bird which is known by the warm ruddy colour of the under parts, and the black crescent on the breast. There are many species of Hermit Humming Birds, inhabiting Venezuela and the Caracas, and choosing those districts where the flora is most abundant. They are all remarkable for two peculiarities, the first being the form of the tail, which is regularly graduated, the two central feathers being the longest, and the others diminishing on either side. The second peculiarity is, that the two sexes are nearly alike in their colouring, contrary to the usual custom among humming birds, the male of which is generally brilliantly clad, and the female quite plain and sombre. All those Hermits whose habitation is known build a curiously

formed nest, funnel-shaped, and attached to the end of some drooping leaf.



LITTLE HERMIT

The example which has been chosen for illustration affords a good idea of the form which is generally followed,

and as may be at once seen, closely resembles that of the fantailed warbler, which has already been described.

The nest which is here figured was attached to the very extremity of the leaf, so that the long tail hung down freely. The materials of which it was composed were the silky fibres of plants, the cotton-like down of seed vessels, and some other substance, which is supposed to be fungus, and is of a woolly texture. All these materials were interwoven with spider's-web, by means of which the nest was attached to the leaf at the end of which it swings. The bird almost invariably chooses some dicotyledonous leaf for its pendant home.

Other nests made by birds of the same genus are worthy of a passing mention.

First, there is the pretty nest of the GREY-THROATED HERMIT, a very tiny bird, of comparatively sober plumage, reddish brown being the predominant hue. This species is found in Ecuador, and is seen at an elevation of six thousand feet above the level of the sea. Indeed, the depth of cold which these fragile little beings can endure is really surprising, many species being found only on the highest mountains, and one bird, the Chimborazian Hill Star, inhabiting a zone that is never less than twelve thousand feet, and seldom more than sixteen thousand, above the level of the sea. Immediately above the last-mentioned elevation the line of perpetual snow begins, and though the bird can exist just below it, the absence of vegetation prevents it overpassing that line.

The nest of the Grey-throated Hermit is made of moss fibres and the same silken threads that have already been mentioned, and is fastened to a leaf. It does not, however, hang from the extremity, but is fastened against the side of the leaf, and its tail, if we may so call the lengthened appendage, is not free, but attached to the leaf in the same manner as the nest.

Our last example of this group is the tiny species called the PIGMY HERMIT, a pretty little creature, though scarcely

a brilliant one, and decorated with green-bronze above and warm red below. The nest of this species is fastened to a leaf, like that of the grey-throated hermit, and is also deep and cup-shaped, with an appendage so long as to give the whole nest a shape resembling that of a funnel. It is remarkable for the great use of which this little architect makes of seeds, the exterior being covered with downy seeds, and the interior lined with similar down, and the delicate fibres of flowering plants.

As the reader may like to know how the tiny architect achieves her graceful task, I introduce a passage wherein Mr. Gosse describes, with the vivacity of an eye-witness, the manner in which the female LONG-TAILED HUMMING BIRD builds its pensile home. The nest is made of fine moss, cotton fibres, spider's web, and studded externally with lichens, and is one of the true pensiles, sometimes being found over water, and in one instance overhanging the sea waves, suspended to a twig of wild vine. The account is as follows :—

“ Suddenly I heard the whirr of a humming bird, and on looking up, I saw a female *Polytmus* hovering opposite the nest with a mass of silk-cotton in her beak. Deterred by the sight of me, she presently retired to a twig a few paces distant, on which she sat. I immediately sank down among the rocks as gently as possible, and remained perfectly still. In a few seconds she came again, and after hovering a moment, disappeared behind one of the projections, whence in a few seconds she emerged again and flew off. I then examined the place and found to my delight a new nest.

“ I again sat down on the stones in front, where I could see the nest, not concealing myself, but remaining motionless, waiting for the bird's reappearance. I had not to wait long; a loud whirr, and there she was, suspended in the air before her nest. She soon espied me, and came within a foot of my eyes, hovering just

in front of my face. I remained still, however, when I heard the whirring of another just above me, perhaps the mate, but I durst not look towards him, lest the turning of my head should frighten the female. In a minute or two the other was gone, and she alighted again on the twig, where she sat some little time pruning her feathers, and apparently clearing her mouth from the cotton fibres, for she swiftly projected the tongue an inch and a half from the beak, continuing the same curve as that of the beak.

"When she arose, it was to perform a very interesting action, for she flew to the face of the rock, which was thickly clothed with soft downy moss, and, hovering on the wing as if before a flower, began to pluck the moss until she had a large bunch of it in her beak. Then I saw her fly to the nest, and having seated herself in it proceeded to place the new materials, pressing and arranging and interweaving the whole with her beak, while she fashioned the cup-like form of the interior by the pressure of her white breast, moving round and round as she sat. My presence appeared to be no hindrance to her proceedings, although only a few feet distant, at length she left the place and I left also."

The bird whose proceedings are thus vividly described is a lovely species, remarkable for the very great length of the two central tail-feathers, which are very narrow, and twice as long as the bird from the point of the beak to the root of the tail. They cross each other as the bird is at rest, and their colour is deep purple-black. The rest of the plumage is most lovely, the upper parts being green, with a golden gloss, and the throat and lower parts emerald-green. The top of the head is deep velvet-like black, and surmounted with a small plume. These are the colours of the adult male, the female being without the two long feathers in the tail, the top of the head brown, and the throat and breast white, slightly speckled with green.

In the accompanying illustration may be seen figures of the nests made by three different species of humming birds, each of which is remarkable for some peculiarity of structure, though they are all pensile.

The first of these nests is that which is made by the WHITE-SIDED HILL STAR, a native of the Andes of Aconcagua, inhabiting a zone of very great elevation, seldom being seen less than ten thousand feet above the level of the sea. With the exception of a bright emerald-green gorget, it is rather a dull-coloured bird, the prevailing hue being brown. The nest is shaped something like a hammock, not unlike that of the lanceolate honey-eater, described and figured on page 53, and is fastened, not to a twig or a leaf or a branch, but to the side of a rock, being suspended by one side so as to leave the remainder free.

As is the case with the generality of humming birds' nests, cobwebs are employed for the purpose of fastening the structure to the object to which it hangs. The materials of which the nest is made are chiefly moss, down, and feathers, the feathers being profusely stuck on the outside.

This is not the only humming bird which hangs its nest from rocks, for the lovely SAPPHO COMET, sometimes called the BAR-TAILED HUMMING BIRD, on account of the dark bars which cross its tail, has a similar custom.

This splendid bird inhabits Bolivia, and is a very familiar and bold little creature. The nest is made chiefly of vegetable fibres and moss, and furnished with a long appendage similar to those which are made by so many humming birds, for no conceivable reason. The nest is lined with hair, probably that of the viscacha, one of the llamas, and is hung against the side of a rock or a wall, sometimes being attached to the wall itself, but generally suspended from some twig or hanging root. The bird always selects some spot where the nest can

be sheltered by an overhanging ledge of rock, probably because the very loose structure of the nest requires that some such precaution should be taken. The portion of the nest that rests against the wall is always looser than the remainder of the structure. There are two eggs, of a rather large size for humming birds to lay, being about half an inch in length.

The CHIMBORAZIAN HILL STAR also hangs its nest against perpendicular rocks.

This singular bird, like its congener, the White-throated Hill Star, prefers elevated situations, and is found at still higher altitudes. Specimens are never found less than twelve thousand feet above the level of the sea, and are frequently seen at the astonishing elevation of sixteen thousand feet, where it thrives in spite of the extreme cold which continually reigns and checks the magnificent flowering plants which are so plentiful towards the foot of the mountain. As may be seen from the name of the bird, it lives upon Chimborazo, and feeds upon the juices of an alpine plant with large blossoms.

It is not a brilliantly coloured bird, the general colours being pale dusky green, relieved by a splendid emerald patch upon the chest. The nest of the Chimborazian Hill Star is made chiefly of lichens, and is hung against the sides of some perpendicular rock, where it is sheltered by a shelf overhead. There is another Hill Star which much resembles this species, but does not possess the green patch on the throat. This species also inhabits a volcanic mountain, being confined within a narrow zone of some two hundred yards in width. It is a remarkable fact, that though this species, which takes its name of PICHIN-CHIAN HILL STAR from the mountain on which it resides, is placed within thirty miles of the Chimborazian Hill Star, neither species is ever found upon the mountain which is appropriated to its congener. Pichinchia is in the republic of Ecuador.

There is a very remarkable nest made by one of these birds, called the SAWBILL HUMMING BIRD, because the slender bill is notched in a saw-like fashion on the edges of both mandibles. These serrations do not reach along the whole bill, but only to a short distance from the tip. In appearance it is not so strikingly beautiful as many of the humming birds, and is chiefly remarkable for its reddish throat dotted with white, and having a black mark down its centre. There are several humming birds which have the serrated edges to the mandibles, and are in consequence called Sawbills, but the present species is the most worthy of notice with respect to its nest. It is only found in the south of Brazil.

The nest of the Sawbill is made of fine vegetable fibres, woven together so as to look like an open network purse, the outer walls being so loosely made as to permit the eggs and lining to be visible. Leaves, mosses, and lichens are also woven into the nest, and are packed rather tightly under the eggs. The edge, however, is always left loose. The nest is suspended at the end of some leaf, usually that of the palm.

Mr Gould mentions that the bird is found in the depths of virgin forests, and is most plentiful about thirty miles from Nova Friburgo, in the months of July, August, September, and part of October. It is generally seen darting round the orchidaceous plants which flower so richly in that fertile climate, and is a rather noisy bird, uttering loud and piercing cries, and making a great whirring sound with its wings as it dashes through the air. It is very strong and energetic on the wing, and is seldom seen to alight. That the Sawbill feeds on insects has been satisfactorily proved, by the presence of small beetles in the throat of newly-killed birds; and to judge by its actions, the hovering flight and frequent stoop like that of the falcon, the bird feeds also on flies and other winged insects.

Although it is necessarily impossible to describe or

even enumerate one tithe of the interesting nests made by humming birds, I must cursorily mention one or two more of the most curious examples. One of these birds is the BRAZILIAN WOOD NYMPH, a species which is perhaps more persecuted than any other, its singular beauty causing its plumage to be sought after.

The feathers on the crown of the head and front of the throat are of the most lovely azure, and are largely used by the inmates of several convents at Rio Janeiro for the purpose of being made into the beautiful feather flowers which the nuns manufacture so skilfully. Thousands of these birds are slaughtered merely for the crest and gorget, but so prolific are they, and so ingeniously do they hide their nests, that the persecution of many years has scarcely diminished their numbers. Moreover, fortunately for the preservation of the species, the colours of the female are so dull and sober, that her feathers are of no value, and she is allowed to escape the fate that befalls the more brightly-coloured male. It is a lively little bird, and when alarmed utters a hurried cry, sounding like the word, "Pip, pip, pip," very sharply pronounced.

The nest of the Brazilian Wood Nymph is exceedingly pretty, and is hung to the tip of some delicate twig, generally that of one of the creeping plants which trail their long stems so luxuriantly over the branches of the great forest trees. The walls of the nest are made of vegetable fibres, generally taken from the fruit of some palm, and upon the outside are fastened many patches of flat lichen, so that the whole nest, which is very long in proportion to its width, may easily escape detection.

The second species is to be found in every collection of humming birds, and even the glass cases of these creatures which are sold in the shops, are seldom without a specimen of the RUBY AND TOPAZ HUMMING BIRD. It derives its name from the rich ruby red which decorates the crown of

the head, and the fiery topaz which blazes on the gorget. This species has a very wide range of residence, being found throughout Bahia, all the Guianas, Trinidad, and the Caracas, and is killed by thousands for the sake of its plumage. I was about to say for the sake of its skin,



SAWBILI HUMMING BIRD

BRAZILIAN WOOD NYMPH

WHITE-SIDED HILL STAR

but as that expression would imply that the humming birds seen in cases are all skinned and stuffed, it cannot be rightly used.

A stuffed humming bird is very seldom seen, though

thousands are annually sold under that name. In fact, the birds are so tiny, and the amount of flesh is so small, that very few persons care to take the trouble and run the risk of skinning such minute creatures, and content themselves with removing the inside, supplying its place with cotton, inserting wires, as is customary in birds stuffed according to the present fashion, fixing the birds in appropriate attitudes, and then drying them, trusting to the feathers to cover deficiencies. Of course the soft and rounded contours are lost by so rough a process, but as the general public that buys stuffed birds is too uncritical to perceive such defects, and too indifferent to trouble themselves about them, even when pointed out, the professional taxidermists have no inducement to waste their time upon tedious and unremunerative work.

We now leave the Humming Birds, and pass to other inhabitants of America.

Still keeping to Brazil, we come upon another pensile bird, called the AZURE CŒREBA. This beautiful little creature scarcely yields to any of the gorgeous humming birds in the glory of its plumage, and far exceeds many of them in the fiery brilliance of its hues. Blue is the chief colour in this Cœreba, and, strange to say, different qualities of blue are found in the same bird, without jarring with each other, so wonderfully are they dispersed and so artistically are the various shades separated by velvet-black stripes and patches. The greater part of the body is rich azure, with the exception of a velvet-black stripe that runs round the crown of the head, and widens into a patch on the back of the neck. The quill-feathers of the wing are also black, and a black streak is drawn from the corner of the mouth to the neck, enveloping the eye in its course.

Separated from the azure blue of the body by the black streak just mentioned, a large patch of feathers on the

top of the head glows and flashes with metallic splendour, and is of a vivid verditer blue.

The nest of the Azure Cœreba is pear-shaped in form, the hollow for the eggs and young being in the large rounded portion, and the slender part of the pear representing the "tail" of the nest, which is long and slender, like that of many birds which have already been mentioned, except that instead of being solid and pointed, it is hollow and has the opening to the nest in the extremity. In order, therefore, to reach the nest proper, the bird is obliged to enter from below and climb up the hollow shaft, as is the case with some of the African weaver birds. The substances of which the nest is made are long vegetable fibres and slender grasses, and the manner in which these simple materials are woven into so beautiful a nest is remarkably ingenious, and may challenge comparison with the architecture of any other bird.

The Azure Cœreba is a small bird, about the size of our sparrow, but with a long, slender, and slightly-curved beak, as is mostly the case with the large and important family to which it belongs. It feeds chiefly on insects, and may be seen busily engaged among the flowers of its native land, flitting from one blossom to another, and daintily extracting the minute insects that endeavour to conceal themselves within the recesses of the petals.

Still keeping to America, we may see more examples of pensile nests. Two differently-shaped specimens are given in the accompanying illustration, in order that they may be compared with each other.

The first in order is that of the BALTIMORE ORIOLE, a pretty bird, coloured with orange and black in bold contrast to each other. Its name is derived, not from any particular locality, but from the orange and black of its plumage, those being the heraldic colours of Lord Baltimore, formerly proprietor of Baltimore. It does not

receive the full colouring until its third year, the orange hues being simply yellow at the end of the second year, and having no red in them until the last moult is completed. So far, indeed, is it from belonging to any particular locality, that it is spread over a very wide range of country, inhabiting the whole of America from Canada to Brazil. The Baltimore Oriole goes by many names; some, such as Golden Robin and Fire Bird, being in allusion to its plumage, and others, such as Hang-nest and Hanging Bird, from the beautiful pensile nest which it makes.

The general shape of these nests is much the same in every specimen, and a good idea of it may be formed from the illustration, which was taken from a nest in my own possession. It is always pensile, and is hung by the rim to the under side of some slender bough, usually at a considerable elevation from the ground. It is almost entirely made of vegetable fibres, and is so strongly constructed, that, although it had been knocked about for some years in the neglected spot whence I rescued it, and was once crushed into a shapeless mass at the bottom of a wine hamper by a careless servant, and covered with soot and dust, it has retained its form, and shows perfectly well how the fastening to the branches was managed.

The materials of the nest are, however, extremely variable, the bird having a natural genius for nidification, and being always ready to take advantage of any new discovery in architecture. One of these nests, described by Wilson, was deeper in proportion than the specimen which has been figured, being five inches in its widest diameter and seven in depth, the opening being contracted to two and a half inches. Various materials, such as flax, tow, hair, and wool, were woven into the walls, which were strengthened by horsehairs, some two feet in length, sewn through and through the fabric. Cow's hair was also employed

for the bottom of the nest, and, like the walls, was sewn together with long horsehairs.



CRESTED CASSIQUE

BALTIMORE ORIOLE

The same writer remarks, that "so solicitous is the Baltimore to procure proper materials for his nest, that

in the season of building, the women in the country are under the necessity of narrowly watching their threads that may chance to be out bleaching, and the farmer to secure his young grafts; as the Baltimore, finding the former, and the strings which tie the latter, so well adapted for his purpose, frequently carries off both. Or, should the one be over heavy, and the other too firmly tied, he will try at them for a considerable time before he gives up the attempt. Skeins of silk and hanks of thread have often been found, after the leaves were fallen, hanging round the Baltimore's nest, but so woven up and entangled as to be entirely irreclaimable.

"Before the introduction of Europeans, no such materials could have been obtained here; but, with the sagacity of a good architect, he has improved this circumstance to his advantage, and the strongest and best materials are uniformly found in those parts by which the whole is supported."

This bird is very fearless, and, like some other species, is fond of the society of mankind, building in gardens and orchards, and piping its mellow notes within the very streets, in calm defiance of the roar and rattle of town life. This fearlessness of disposition enables observers to watch its proceedings very closely, and in general the bird is found to begin its nest by working the strongest threads or strings round a forked branch, so as to mark out the entrance, and then by weaving the remainder of the nest upon the strings. The neatness and strength of construction are, however, very variable; and it is suggested by Wilson that the inferior nests are probably made by young and inexperienced birds, their architectural powers increasing with practice.

A closely allied species, the ORCHARD ORIOLE, or BOB-O-LINK, is equally notable for its skill in nest-building

—if such a word may be used of a structure which is begun at the top and carried downwards, after the fashion employed in Laputa.

It is a pretty bird, but not so pretty as the Baltimore Oriole, and the tints are very differently disposed, scarcely any two individuals having the colours in exactly the same places. Like the Baltimore Oriole, it is extremely variable in different stages of its existence, the young male bearing great resemblance to the mature female, and not attaining its full beauty until its third year. When adult, the whole of the head, neck, upper part of the back, breast, wings, and tail, are deep black, and a rich ruddy chestnut hue occupies the remainder of the breast, the under parts of the body, and part of the wing-coverts, some of which are tipped with white. The young male and the adult female are yellowish olive above, instead of black, with brown wings, and yellow on the breast and abdomen; while the male of the second year has much the same colours, but is known by a patch of black over the head and on the throat, together with a few chestnut feathers on the flanks and abdomen. It is smaller than the Baltimore Oriole, and more slenderly made.

The nest of this bird is almost as variable in structure as is its architect in colour, its form being accommodated to the situation in which it is placed. When fastened to a tolerably stout branch, its depth is less than its diameter, and it is firmly tied in several directions to prevent the wind from upsetting it. But when it is slung to a long and slender branch, over which the wind has great power, and which is swung to a distance of fourteen or fifteen feet in a smart breeze, the nest is made of much greater depth, and is of a lighter construction. The weeping willow is a favourite tree with this bird, as the drooping leaves conceal the nest effectually, and the delicate twigs can be gathered together so as to support the entire circumference of the entrance.

Wilson remarks, in allusion to these nests, that they "exhibit not only art in the construction, but judgment in adapting their fabrications so judiciously to their particular situations. If the actions of birds proceeded, as some would have us believe, from the mere impulses of that thing called *instinct*, individuals of the same species would uniformly build their nests in the same manner, wherever they might happen to fix it; but it is evident, from those just mentioned, and from a thousand such circumstances, that they reason, *& priori*, from cause to consequence, persistently managing with a constant eye to future necessity and convenience."

The popular name of Orchard Oriole is given to this species because it is a familiar and bold bird, not in the least fearing the vicinity of man, but rather seeming to find a protection therein, and loving to build its pensile nests in orchards. As is the case with many British birds, it long had an evil reputation which it did not deserve, and was thought to devour the ripe fruit of the trees in which the nest was placed. Cultivators now know better, and are aware that, so far from being a foe, it is one of their best friends, eating vast numbers of the noxious insects which infest fruit trees, and saving many a crop by its exertions to procure food for itself and young family.

Indeed, one of the nests has been observed to be completely overshadowed by a large bunch of apples, which had grown over the entrance, and had absorbed more than half the space through which the bird was accustomed to enter its home. Yet, although the destruction of the fruit would have been a positive convenience to the Oriole, not a single apple was touched, and the bird slid in and out of its nest as cautiously as if it were aware of the value set on the fruit, and determined not to injure it.

On the left hand of the Baltimore Oriole's nest is repre-

sented a very curious structure swaying in the wind, long, purse-like, and having the entrance near the top. This is the nest of the CRESTED CASSIQUE, or CRESTED ORIOLE, and the bird itself is seen clinging to the lower part of the nest.

There are several species of Cassiques, all of which are natives of tropical America, and build nests of a similar structure. The Crested Cassique is the largest of the genus, equalling the common jackdaw in size, and its nest is larger and more striking than that of any other species. It loves the tallest trees, and may be seen actively traversing the branches in search of food, pecking here and there in haste as it trips along, or passing from one tree to another with a rapid darting flight, snapping at insects as it dashes through the air. Like the preceding species, it is fond of human society, and builds its pensile nest close to the habitation of man, so that its customs can be easily watched.

The bird is a handsome creature, the greater part of the body being rich chocolate, the wings dark green, and the outer tail-feathers bright yellow, this colour being displayed conspicuously as the bird flies, particularly when it makes a sharp turn in the air and is obliged to spread its tail-feathers rapidly. The beak of this species is very remarkable, being of a green colour, and extending far up the forehead. The head is adorned with a long pointed crest, from which its popular name of Crested Oriole is derived. In some favoured spots these birds are quite plentiful, producing a beautiful effect, as the variegated plumage gleams among the foliage, while the bird is engaged in its active quest after food.

The nest of the Crested Cassique is of great length, and, as may be seen by the illustration, has the entrance like that of a pocket. The opening is rather small when compared with the size of the nest itself, and the bird always dives head foremost into its home, its yellow tail flashing a last golden gleam before it disappears. The nest is

strongly built, and the materials are rather coarse, not in the least resembling the delicate and neatly-rounded fibres of which many of the weaver nests are made. These nests often exceed a yard in length, and owing to their great size, are very conspicuous, as the wind sways them backwards and forwards from the bough.

The same may be said respecting the nests of other Cassiques, and the stay-at-home reader is often apt to wonder why the traveller does not ascend every tree on which he sees a nest, and bring it down. There are two reasons why such nests are not so common in European museums as their number would seem to promise. One reason is, that the trees are not easily climbed. Some of them run to a height of eighty or a hundred feet without a bough; others have stems of great girth and wondrous smoothness, so that to ascend them is as difficult as to climb a greased pole at a fair; others again, which do not appear to present any difficulties, have their stems beset with thorny spikes, from an inch to two inches in length, as strong as nails and as sharp as needles.

Supposing, however, that the traveller is a practised climber, and always carries with him a rope and climbing spurs, and that by dint of the pointed spurs sticking into the tree, and the strong leather gaiters repelling the thorns, and the rope enabling him to pull himself upwards, he has arrived at the branches, he still finds many an obstacle to overcome. In the first place, distances are mightily deceptive when viewed from below, and a nest which appears from the ground to be close to a certain branch, is found really to be some yards on one side, and as many above.

Most birds, especially the tropical birds, have a custom of placing their nests at the very ends of boughs, where the twigs could not sustain the weight of a monkey, much less that of a man; so that the adventurous climber finds himself scarcely nearer his object than when he stood

upon the ground. Such nests can only be obtained by skilfully throwing a rope around the branch to which they are hung, drawing it up, severing it as near the nests as possible, and then lowering the whole to the earth.

Supposing, however, that he has successfully overcome his difficulties, and has been able to reach the nest, he still finds himself in a very awkward position on account of the multitudinous insects which swarm upon tropical trees, and the majority of which can either sting or bite savagely. There are many kinds of wasps, larger, fiercer, and more irritable than the little yellow and black insect which terrifies us so much in this country, and these creatures have a habit of fixing their nests among the branches, where they are concealed by the leaves, and cannot be seen by the climber until he nearly strikes them with his hands.

But the very worst of all his foes are the ants and termites, which infest the trees to a wonderful degree. The ants are of various kinds. There are arboreal ants, which make their nests among the branches, and there are terrestrial ants, which make their home under the earth, but ascend the trees in search of insects or to procure materials for their subterranean abode.

The termites, again, are found on many trees, and in some instances actually hollow out the branches, so that when the climber grasps a bough, for the purpose of hauling himself up by it, the treacherous branch breaks in his hands, and pours out a flood of angry insects, all provided with means of offence, and anxious to wreak their vengeance on the enemy. Even the natives, accustomed as they are to these pests of their woods, and versed in every method of foiling them, confess themselves worsted by the ants, and are often forced to yield the point to their tiny foes.

In some cases, they attack so fiercely that the unlucky

climber is perforce obliged to descend the tree with all speed, and envelop himself in smoke in order to rid himself of his adversaries ; or, whenever a river flows beneath the branches, the tortured native is fain to fling himself into it, and to drown off the myriad insects who are burying their jaws, or stings, or both, in his flesh. A naturalist's labours in a tropical forest are very pleasant reading at home, but they are not quite so pleasant to perform, even setting aside the chances of fever, and snake bites, and the certainty of being sucked by thousands of mosquitos, sand flies, and other winged plagues.

Before leaving the American pensile birds, we must briefly notice one or two other species. The Flycatchers of all countries are generally notable for the beauty or eccentricity of their nests, one of the oddest being that of the GREAT CRESIED FLYCATCHER of America, which always uses the cast slough of snakes when building its nest. The reason no one seems to know, though several opinions have been offered ; one person thinking the snake-slough is peculiarly grateful to the young birds which are intended to lie upon it ; and another, that the presence of the cast slough acts as a scarecrow, and frightens away obnoxious birds. One conjecture is as good as another, and both are absurdly bad.

The species which we have now to notice is the RED-EYED FLYCATCHER, popularly known as "Whip-Tom-Kelly," from its peculiar articulate cry, which is said to bear a strangely exact resemblance to the words "Tom Kelly, Whip-tom-kel-ly," and is uttered so loudly and briskly, that it can be heard at a considerable distance. It inhabits a tolerably wide range of country, being found from Georgia to the St. Lawrence, and in many parts is plentiful.

The nest of the Red-Eyed Flycatcher is small and very

neatly made, and, contrary to the usual custom of pensile nests, is placed near the ground, seldom at a height of more than five feet. Bushes and dwarf trees, such as dogwood or saplings, are usually chosen by the bird when it looks about for a branch wherefrom to hang its nest. A wonderful array of materials is employed by the feathered architect, which makes use of bits of hornets' nests, dried leaves, flax-fibres, strips of vine bark, fragments of paper and hair, and binds all these articles firmly together with the silk produced by some caterpillars. The lining is made of fine grasses, hair, and the delicate bark of the vine.

The nest is wonderfully strong, so compact indeed, that after it has served the purpose of its architect, it is usurped by other birds in the following year, and saves them the trouble of building entire nests of their own. Even the mammalia receive some benefit from the nest, for the field-mouse often takes possession of it, and rears its young in the pensile cradle.

An allied species, the WHITE-EYED FLYCATCHER, builds a very pretty pensile nest, and uses so much old newspaper in the construction of its home, that it has gone by the name of the POLITICIAN. The other materials used in the structure of the nest are bits of old rotten wood, vegetable fibres, and other light substances, woven together with wild silk, and the lining is mostly of dried grasses and hair.

The form of the nest is nearly that of an inverted cone, and it is suspended by part of the rim to the bend of a species of smilax, that is popularly called the prickly vine, and which grows in low thickets. The bird is very fond of this smilax, and rarely chooses any other tree for the reception of its nest, so that the home of the White-Eyed Flycatcher is not very difficult to find; moreover, the bird is so jealous and so bold when engaged in rearing its young, that it betrays the position of the nest by scolding angrily as soon as a human being approaches

the thicket, and by dashing violently at the intruder with impotent rage.

Another pensile species is the PRAIRIE WARBLER, a bird which, as its specific name denotes, is of very small size, not reaching five inches in total length.

It is a lively little bird, but withal deliberately cool in its movements, flitting about among the foliage and grass with a quick, though jerking, regular movement, and yet inspecting every leaf and blade with perfect composure; chirping feebly all the while, and allowing itself to be watched without betraying any alarm. The nest of this little bird is unusually small, even when the size of the feathered architect is taken into consideration, and when dry weighs scarcely a quarter of an ounce. The materials of which it is made are moss, mixed with rotten and very dry wood, fastened together with caterpillar-silk, and the lining is made of very fine and delicate fibres of grape-vine bark.

Our last example of American pensile birds is the PINE-CREEPING WARBLER, a pretty little species, which has many of the actions that characterise the titmice, flitting among the branches like these birds, and hanging head downwards from the twigs while looking for insects. Sometimes it runs along the ground, and is equally active there; and when disturbed, it flies upwards, and clings to the trunk of the nearest tree, the whole movement being so peculiar that the bird can be distinguished at a long distance.

The Pine-Creeping Warbler is found in the pine-woods of the Southern States, where it assembles in little flocks of twenty or thirty in number. Its nest is suspended from the horizontal fork of some small branch, and is made of strips of grape-vine bark and rotten wood, tied firmly together with caterpillar-silk. Sometimes the bird finds a hornet's nest, and rightly considering that

the substance of which it is made is the driest and lightest rotten wood that can be obtained, robs the insect, and builds its own nest with the spoils. The interior of the nest is lined with the fine roots of plants and dry pine-leaves, which latter materials afford a softer bed than their shape seems to indicate.



BAYA SPARROW

As we are near the end of our list of pensile birds, we must turn to Asia for a specimen as remarkable as any which has yet been mentioned. This is the nest of the BAYA SPARROW, sometimes called the TODDY

BIRD, a native of several parts of India, and found in Ceylon.

As may be seen by the illustration, the nests are variable in shape, and hang close to each other; indeed, the birds are very sociable in all their manners, and fly about in great numbers, flocks of thousands flitting among the branches and displaying their pretty plumage to the sun. They have no song, and can only chirp in a monotonous manner; but the want of song finds its compensation in the brilliancy of the plumage, which is mostly bright yellow, the wings, back, and tail being brown. They are particularly fond of the acacias and date-trees, and choose the branches of those trees for the suspension of their nests.

Sometimes the nest is only made for incubation, sometimes it is intended merely as an arbour in which the male sits while the female incubates her eggs, and sometimes it consists of the nest and arbour united, producing a most curious effect. This "arbour," in fact, serves precisely the same purpose as the supplementary nest of the pinc-pinc and other birds which have already been described.

## CHAPTER V.

*PENSILE INSECTS*

The Hymenoptera—Australian Insects—The Crematogaster and NEGRO-HEAD—The GREEN ANT—Its habits and nest—An African species—Pensile Ants of America—The ABISPA, and its remarkable nest—Ingenious entrance—The TATUA, or DUTCHMAN'S PIPE—Structure and shape of its nest—Firmness of the walls—Average number of cells in each tier—The COMMON WASP as a Pensile Insect—Gigantic nest—Union of three colonies—Character of the Wasp—The NORWEGIAN WASP—Structure and locality of its nest—Classification of the Wasps—The CAMPANULAR WASP and the NORTHERN WASP—The CHARTERGUS or PASTEBOARD WASP—Mode by which the nest is suspended—Method of structure—Meaning of the name—Enormous nest from Ceylon—Various Wasp nests—The POLISTES as a Pensile Insect—Singular nest in the British Museum—The GIBBOUS ANT—Honey Wasps—The general characteristics of their nests—The MYRAPETRA—Its singular nest—Structure of the walls and use of the projections—The NECTARINIA—Why so called—Locality of the nest—Size of the insect—The TRIGONA and its nest—Ichnneumon Flies—Different species of MICROGASTER, and their habitations—The PERIITLES—Weevils—Beautiful Cocoon of Cionus—The EMPEROR MOTH and its home—The ATLAS MOTH and other silk-producers—The HOUSEBUILDER MOTH and its movable dwelling—The TIGER MOTH and its hammock—The CYPRESS-SPURGE MOTH—Various leaf-rollers—Suspended cocoon—LEAF-BURROWERS and their homes—The SPIDER.

WE now leave the birds, and proceed to the insects which make pensile nests. Some of them, such as those which will be first described, do not become pensile archi-

tects until they have attained their perfect state; while many others form their nests, either as a place of refuge during their larval life, or as an asylum in which they can rest while in the transition state of pupa.

Just as the Hymenoptera are the best burrowers, so are they the best insect artizans when the nests are suspended, and we shall therefore take them first in order. The reader will probably recall to mind during the perusal of the following pages that several admirable examples of pensile nest-makers are not mentioned. The reason for their temporary omission is, that some of them make their nests of mud, and will therefore be described under the head of Builders; while others make their joint homes on so large a scale that they will be considered under the head of Social Nest-makers.

Upon the large illustration will be seen several examples of pensile nests; and, as many Australian insects are remarkable for the beauty and singularity of the pensile nests which they build, I have selected three of the most remarkable instances for illustration. Adhering to the principle which has been followed throughout the work, the scene of the drawing has been laid in Australia, and the general contour of the country, the peculiar foliage, the animals which enliven the scene, and the singular manner in which a wooded district is often dotted with trees, have been carefully represented.

In the upper corner of the drawing is seen the large nest of a remarkable ant, called *Crematogaster laeviceps*. I do not know whether this species has any particular name, but in the Brazils an allied species goes by the name of Negro-head Ant, because the nest is round, like the bullet-shaped head of a Negro, and is covered on the exterior with little projections that are supposed to resemble the close woolly hair.

When the ant runs about, it has a curious habit of holding its abdomen so high in the air that it curves over



GEOPHYLLA VIRESSENS.

ABISPA EPHIPPUM

CREMATOGASTER LAVICEPS.

the back and overhangs the thorax, a peculiarity which has earned for the genus the name of *Crematogaster*, or "hanging-belly." At first sight the nest bears a close resemblance to the pensile habitation of certain wasps, but when subjected to a nearer examination it proves to be even more complicated, being composed of multitudinous curved and intricate ramifications, all leading to the interior galleries and cells.

In the left-hand corner of the illustration is seen another rounded nest, also made by an ant, called *Ecophylla irens*. Travellers know it by the name of the GREEN ANT; a title which is very insufficient, as it embraces several other species. The name of *Ecophylla* is compounded of two Greek words, the former signifying a house, and the second a leaf, and is given to this insect because it makes its home of dead leaves.

This ant is sometimes very troublesome to travellers, who may unconsciously disturb one of the nests that hang among the branches, nearly concealed by the leaves. The ants come patterning down like hail-drops, and in a moment he will be covered with a whole swarm of them, seeking for unprotected parts which they can wound, and having a special faculty for getting down the neck.

The nest is about eight inches in diameter, and is made in a very singular manner. The general mass of its substance is composed of leaves which have been cut by the ants and masticated until they form a coarse pulp, something like that which is made by the wasp and hornet, except that the material is green leaves instead of wood fibres. With this substance the nest is formed, and is hung among the thickest foliage, being sustained not only by the branches, but by the leaves, which are worked into the nest and in many parts project from its outer wall. The outside of the nest is easily to be distinguished from that of the *Crematogaster* by the smoothness and regu-

larity of its walls. A species of this genus inhabits Africa, and was discovered by Mr. Foxcroft, who noticed that whenever the ants were disturbed, they ran about the outside of their nests so fast and in such numbers, that their pattering steps on the papery covering of the nest deluded him into the idea that rain was falling on the leaves above.

Before describing the third nest in the illustration, which is the workmanship of a wasp, I will briefly mention one or two remarkable instances of pensile nests made by ants. One species, *Formica bispinosa*, which inhabits Central America, makes use of the silk-cotton which is produced by the seed-vessels of the cotton-tree, and makes it into a sponge-like mass, which much resembles amadou, and, like that substance, is extremely valuable for stopping violent discharges of blood.

Another ant, *Formica merdicola*, rivals the Myrmica Kirbi in the singularity of the material which it uses in the construction of its nest, employing horse-dung for that purpose, and fixing its home either on the stems of reeds, at some distance from the ground, or on the spiny trunks of certain palms. There are also ants which form their nests from vegetable hairs, such as the *Formica molestans*, which employs extremely minute hairs, and makes with them a nearly globular nest, which is placed in the petioles and vesicles of different plants.

We now proceed to the third figure in the illustration, placed upon the tree near the centre. This represents the remarkable nest of *Abispa Ephippium*, an Australian insect, belonging to the wasp tribe.

The nest is not very large, being about three or four inches in diameter, and rather more in height, exclusive of the entrance-tunnel. The material is clay, kneaded and masticated by the insect until perfectly plastic, and then moulded into a very remarkable form.

The exterior view of the nest presents a curious outline, showing the pipe through which the insect enters, and which reminds the observer of the tube constructed by several pensile birds. Strange as is the external appearance of the nest, a longitudinal section shows a still more extraordinary construction of the interior. The tube does not merely act as an entrance, but is carried about an inch into the interior of the nest, possibly in order to prevent the young insects from falling out before they are fit to cope with the world. The bottom of the nest through which it passes is nearly flat, and the whole shape of the edifice is not unlike a large clay thimble, with the opening closed by a circular flat cake of hard mud.

Attached to the ceiling of the nest is a single layer of cells, arranged without any particular order or regularity ; and it is a curious fact, that only a single wasp has been observed in the act of building the nests, or making the interior arrangement.

In the accompanying illustration may be seen two specimens of a remarkable pensile nest that is made by a wasp called *Tatua morio*, an insect which is notable for having the basal segment of the abdomen narrowed into long and slender footstalks, not unlike that of the *Eumenes*, and others.

The nest of this species is made of the papery substance used by many wasps, except that the material is so hard and smooth as to resemble white cardboard. The general form of the nest is shown in the engraving, being somewhat like a sugar-loaf, i.e., a round-topped cone with a flat bottom. It is found in several parts of Central America ; and in Guiana the nest goes by the popular name of "the Dutchman's pipe," being supposed to bear, in shape and dimensions, some resemblance to the pipe-bowl celebrated by Washington Irving. The exterior walls are so hard, firm, and smooth, that they can withstand

any vicissitudes of weather, neither the fierce storms that blow in those regions, nor the torrents of rain that

*TATUA MORIO*

occasionally fall, having any power over an edifice so well protected.

The tiers of cells are variable in number; a rather remarkable fact, as the floors are made before the cells are built. In a good specimen of this nest in the British Museum there are only four tiers of cells. How many tiers are completed before the insects begin to affix cells to them, or whether the cells are made as soon as the floors are finished, are two points in the history of this wasp which have not yet been decided. These floors extend completely to the walls, to which they are fastened on all sides, and the insects gain admission to the different floors by means of a central opening which runs through them all.

In Mr. Waterton's museum, at Walton Hall, are several specimens of these nests, one of which is cut open so as to show the interior, as well as the central aperture, the whole of the bottom being cut away and raised like the lid of a box. The substance of this nest resembles thin brownish pasteboard, and, as is the custom with most of the wasp tribe, the cells are placed with their mouths downward, the nurses being enabled to attend to their charges by remaining on the floor of the next tier of cells. Taking one row of cells as an average, I counted twenty-four from the central aperture to the circumference, thus giving a tolerable notion of the number of cells in each tier. The aperture is not precisely in the middle, so that some rows of cells are necessarily larger than others, but I purposely selected a row which seemed to afford a fair average.

The COMMON WASP figures in several capacities. It has already been mentioned as a Burrower, deserves notice as a Social Insect, and must now be briefly described as a builder of pensile nests.

In the splendid museum at Oxford, there is an object which never fails to attract the notice of visitors, whether entomologists or not. It is a square glass case, some four feet in height by two in width, and the interior of this

large case is almost entirely filled by a single wasp's nest. This enormous nest resembles a turnip in shape, but with the addition of a large knob at the top, by means of which it is suspended.

Its origin is sufficiently remarkable. On the 18th of July 1857, this nest was found at Cokethorpe Park, Oxfordshire, being then of moderate dimensions, and measuring about five inches in diameter. It was taken from the ground, and hung near the window of a dwelling-house upon the ground floor, so as to give the inmates facility for procuring food. There was no danger in the experiment, for the wasp is really a good-natured insect, unless irritated, and can be watched as safely as the hive bee.

In order to induce the labourers to work with more assiduity, the wasps were supplied with food in the shape of sugar and beer, of which mixture they consumed a large amount, their daily allowance being a pound of sugar to a pint of beer, and the aggregate weight being two pounds. Under such favourable auspices they built their nest at a wonderful rate, when they were suddenly reinforced after a singular manner. It so happened that on the first floor of the house two other wasps' nests had been placed. The workers of these nests were not fed like their kinsmen below, and in consequence, about the end of August they deserted their own house, and united with the more favoured wasps on the ground floor. The three colonies having thus joined their forces, the nest grew with marvellous rapidity, and at last attained the gigantic size which has already been mentioned.

In shape it is very irregular, as though the turnip to which it was compared had been made of a soft yielding substance, and had been thrown down and roughly handled. The entrance is close to the bottom of the nest, and a little on one side, and just by the opening the nest is flattened, and seems as if it had been

pinched by some giant finger and thumb. For this singular structure we are indebted to Mr. S. Stone of Brighthampton

There are also certain British wasps which always make pensile nests, though none of them are so complicated or so finely constructed as those of the pasteboard wasps of hotter climates.

These are popularly called TREE WASPS, and the best known among these pensile wasps is the insect which is sometimes known as *Vespa Britannica*, but which is now named *Vespa Norwegica*, and may therefore be called the NORWEGIAN WASP. I may here mention that, until a very late period, the history of the wasp—whether British or foreign—was in dire chaos, the species, sexes and varieties being so confounded together, that even the best entomologists could make nothing of them.

In Mr Westwood's admirable "Classification of Insects," published in 1840, the following passage occurs, showing how keenly an accomplished entomologist could feel the want of sound information on a difficult subject. In Vol II of that work, page 248, Mr. Westwood remarks as follows: "The specific differences of the British species of wasps require a more minute investigation than has yet been given to them. This can only be done by studying the habits of the different species, in conjunction with individuals of the different sexes from the nest of each. Thirty years ago the necessity for such an inquiry was pointed out by Latreille, who added 'Utinam exergat alius Kirby, qui hanc familiam elucidaret' (i.e., 'Would that another Kirby would arise, who would elucidate this family.') But the wasps still remain in as great or greater confusion than they were at that period."

Since that time, the "other Kirby" has arisen in the person of Mr. F. Smith, who has disentangled the knotty confusion in which the wasps were enveloped, and has

recorded his observations in the Catalogue of Hymenoptera in the British Museum, published by order of the trustees in 1858, some forty-eight years after Latreille had invoked assistance.

Of the species in question Mr. Smith remarks that it is rare in the South and West of England, but is not uncommon in Yorkshire and plentiful in Scotland. It seems to be a nocturnal insect, for a collector of lepidoptera found that when "sugaring" trees at night, for the purpose of attracting moths, numbers of these wasps settled on the sweet bait, and not only were more numerous than the lepidoptera, but actually resented any attempts at dislodgment.

The nest of this insect is always pensile, and is hung from the branches of a tree or shrub, the fir and gooseberry being the favourites. A pretty specimen in my own collection was taken from a gooseberry-tree in a garden, and another similar nest was found at no great distance. One of these nests I presented to the British Museum, and the other is now before me. It is very small, only having one "terrace," in which are thirteen cells, arranged in five rows, four being in the central row, and the rest graduating regularly. It is almost as large as a well-sized turnip radish, and something of the same shape, supposing the radish to be suspended by the root, and to be cut off just below the leaves. The outer envelope is composed of three layers overlapping each other, which are very fragile, considering the work they have to perform.

The wasp itself is prettily marked, and although it is variable in colouring, can be recognised by the black anchor-shaped mark on the clypeus, and the squared black spot on the segments of the abdomen.

Another species of British Tree Wasp is the CAMPANULAR WASP, a species which has received a multitude of scientific names, but which is not variable in colour as that which

has just been mentioned. Though it has a wider distribution than the Norwegian wasp, it is scarcely so plentiful an insect, and is remarkable for an occasional habit of making a subterranean nest like that of the common wasp. The NORTHERN WASP is another of the pensile wasps, and is mostly found in the North of England and Scotland. Its nest is built in fir-trees. I may perhaps mention that the tree wasps may always be distinguished from their subterranean brethren by the colour of the antennæ, workers and females having the scape black in the ground wasps, and those which build in trees having it yellow in both sexes.

The nest of the tatua, which has recently been described, must not be confounded with that of the PASTEBOARD WASP, although both insects inhabit the same country, and the nest of the latter bears a great external resemblance to the pendulous nest of the tatua. But when examined closely, this nest is seen to have a remarkable addition to its structure, the hole through which the branch is passed being very large, so as to permit the nest to swing freely in the wind. In most specimens of these nests the hole is simply made through the thick upper end of the structure, but in a few examples the pasteboard-like substance is so moulded that it looks as if a ring had been added to the top of the nest.

The dimensions of the Chartergus' nest are extremely variable, each structure appearing to be capable of unlimited enlargement. The mode by which the wasps increase the size of their pensile home is equally simple and efficacious. When the number of the inhabitants becomes so large that a fresh series of cells is required, the insects enlarge their home with perfect ease, and at the same time without destroying its symmetry, a point which is often forgotten when human architects undertake the enlargement of some fine old edifice. Taking

the bottom of the nest as the starting-point, they build upon it a series of cells, taking care to add another row or two to the circumference, so as to increase the diameter in proportion to the length. They then add fresh material to the outer wall, which is lengthened so as to include the new tier of cells, and then the bottom is closed with a new



CHARTERGUS NIDULANS.

floor, which in its turn will become the ceiling of the next tier of cells.

These nests are therefore permanent; unlike the habitations of the common British wasps, which are only used for a single season and then deserted, the few surviving females seeking their winter quarters elsewhere, and always choosing some fresh spot for the nucleus of a

fresh colony. On the average, a well-sized nest of the Chartergus is about one foot in length and of proportionate width, a few being found of larger dimensions and many of smaller. Now and then a positive giant of a nest is discovered where the colony has not only been undisturbed, but surrounding circumstances have been favourable to its continued increase. The name Chartergus is derived from two Greek words, signifying paper-maker.

One of the largest, if not the very largest, of these pasteboard nests that has yet been discovered, was found in Ceylon, attached to the inside of a huge palm-leaf, and was of the astonishing length of six feet. Now, to form an idea of a nest six feet in length is not very easy. It is as easy to write the words six feet as six inches, but the idea which is to be conveyed is another matter, the cubical measurement being absolutely enormous.

The gigantic wasp's nest which has lately been described is so conspicuous an object that, although it is only a little more than three feet in length, no one can enter the room without noticing it. But a nest six feet in length is so huge as scarcely to be credited except from actual sight. Such a nest could hardly be taken through an ordinary doorway, and there are few houses of the modern build which could receive it into any room except through the window after both sashes have been removed. We all know how conspicuous among ordinary men is one who measures six feet in height, and we shall form a better idea of the nest in question, if we reckon it to be equal in length to a "six-foot" man, and of course to occupy much more space, on account of its bell-like shape.

Mr. Westwood mentions the nest of an allied species of wasp, which is about eight inches in diameter, and is so hard and smooth on the exterior, that it almost seems to be made of pottery instead of vegetable fibre.

This nest is in the museum of the Jardin des Plantes in Paris.

I have already mentioned that there are many genera of nest-making insects, whose habitations are in some degree similar, and yet present such salient points of difference that they must be classed under different heads. Such, for example, is the strange genus *Polistes*, which is spread over a large portion of the globe, and which makes so singular a variety of nests. However different they may be, there is always one point of union among them : that the cells are exposed to the air without any covering at all, and in consequence, are made of stouter material than those of ordinary wasps, which protect the cells from the weather by a covering.

Many of this species make a nest of a nearly circular shape, and attach it sideways to branches, walls, trunks of trees, or other supports ; but there is a very curious nest in the British Museum which is made on a totally different principle, the combs looking as if they were soft, flexible, and hung carelessly over a twig. There are three of these remarkable combs, having the cells very like those of the common hive bee, both in shape and size, but all being of a dark brown hue. The cells are laid on their sides, like those of the bee, and the combs are long and narrow, looking like one large comb cut into three strips. This curious nest came from Siam.

In the accompanying illustration are represented two nests, both from tropical America, and both found in similar localities. These are the habitations of two species of wasp, which are remarkable for their honey-making powers.

In the year 1780, a Spanish officer named Don Feliz de Azara was raised from the rank of captain to that of lieutenant-colonel, and sent to Paraguay, in order to

decide a dispute concerning the limits of the possessions respectively held by Spain and Portugal.

He was then thirty-four years of age, and being a man of great energy, set to work out the construction of a map of Paraguay. This was a Herculean task, occupying thirteen years in its completion, and forcing De Azara to explore regions before unknown, and to trust himself to the native tribes who had never before seen the face of a white man. While engaged in this occupation, he made a vast collection of notes upon the native tribes of Paraguay, as well as upon the beasts, birds, insects, and vegetation, together with an account of the method by which the Jesuit missionaries established themselves and ruled the country for many years.

After his return to Europe, in 1801, he published the account of his travels, and met with the usual fate of those who first penetrate into unknown countries. His statements were not believed, and among those which raised the greatest discredit was an account of certain wasps which made honey. Some persons said that the whole statement was a fabrication, and others remarked that the honey-making insects were simply bees which De Azara had erroneously considered to be wasps. Time, however, has its usual effect, and De Azara has been proved to be perfectly trustworthy in his remarks. The two specimens which are represented in the illustration are now in the British Museum, and afford tangible proofs that De Azara was right and his detractors wrong.

The right hand figure represents the nest of a curious insect, named by Mr. Adam White, *Myrapetra scutellaris*. The generic title is not very appropriate, being simply a fanciful name, composed of the names of two ancient cities, one called Myra, in Lycia, and the other Petra, the capital town of Arabia Petræa.

It is much to be regretted that this plan of inventing fanciful names and giving them to newly-discovered

species should have been so common a practice among systematic zoologists. I hold that both the generic and



NECTARINIA

specific name of every animal and plant should be intelligible, and refer either to some peculiarity of form, habit,

colour, or locality. There is no great difficulty in doing so. Greek is a language that affords an inexhaustible supply of compound words, and even if the nomenclator be no scholar, any one who is moderately versed in the classics would compose the desired names if he were only furnished with the necessary information.

The vagaries in which some nomenclators indulge are so absurd as scarcely to be believed. Firstly, they will invent some word that exists in no language whatever, merely because the sound pleases their ears, and they like to amuse themselves with the conjectures of future zoologists. Then they will divide the word into its syllables, and make new words with them. Then they will break it up into its component letters, and make as many anagrams as can be pronounced.

It is quite bad enough to name a new species after some particular friend, or after your favourite dog, horse, or cat, or after the name of your house; or, as in the present instance, to name an American insect after two defunct cities of Asia and Africa. The former cases show that you have a friend, or a dog, or a cat, or a horse, as the case may be; and the latter affords conjecture that you have a Lempriere's Dictionary. But the allocation of meaningless syllables in order to form a word which was never intended to have any meaning at all, is so utterly senseless and so completely without excuse that no words of reprobation are too strong for it. The very essence of scientific nomenclature is to convey ideas, whereas the names invented by the delinquents in question are chosen just because they convey no ideas at all.

Such persons shelter themselves behind the great name of Linnæus, saying that his fanciful separation of the butterflies into Greeks and Trojans, knights and commoners, was quite as indefensible as their own system, and that the name of an ancient warrior conveys no idea of a butterfly. But in the days of Linnæus, the father

of scientific nomenclature, the art was in its infancy, and necessarily crude and imperfect; and there is no doubt that if Linnæus had foreseen the enormous discoveries of later times, he would have carried out fully the plan which he generally followed, and have made all his names descriptive.

Scientific nomenclature is of necessity quite complicated and crabbed enough without the infusion of a meaningless element, and those authors who introduce such terms are doing their best to deter future students of zoology, and to render it a repulsive rather than a fascinating science.

When we look at the remarkable nest which is made by the Myrapetra, one cannot but see a vast number of peculiarities which would have furnished an appropriate name, a name which would have stamped upon the mind something of the character of the insect architect.

This beautiful nest was presented to the Museum in the year 1841 by Walter Hawkins, Esq., and a very elaborate memoir by Mr. Adam White is to be found in the "Annals of Natural History," vol. vii. page 315.

On looking at the exterior of the nest, our attention is at once excited by the material of which it is made, and the vast number of sharp tubercular projections which stud its surface. In colour it is dark, dull, blackish brown, and its texture somewhat resembles very rough papier mâché. On examining it with a pocket magnifier a matted structure is plainly visible, as if it were made of short vegetable fibres. This appearance accords with the accounts of the natives, who say that it is made from the dung of the capincha, one of the aquatic cavies of tropical America.

The whole of the exterior is thickly studded with projections, varying in size and shape, but being all of some sharpness at the tip. These projections are comparatively

few at the top of the nest, becoming gradually more numerous as they approach the bottom, until at last they are set so thickly that the finger can scarcely be laid between them.

The object of these projections is not ascertained. The nest always hangs very low, seldom being more than three or four feet from the ground, and some writers say that the office of the sharp projections is to guard the nest from the attacks of the felidæ and other honey and grub-loving mammalia. Such may indeed be the true explanation, and indeed it is so obvious that no one could avoid seeing it. But I very much doubt whether a far better explanation is not in store, and I cannot see why the *Myrapetra* should stand in need of such protection, when the nest of the *Nectarinia*, which is placed in precisely the same conditions, is perfectly smooth and defenceless.

One use of the projections is evidently for the double purpose of concealing and protecting the entrance. On looking at the nest from above, no entrance is visible, and it is not until after a close examination that the openings are found. They are concealed under a row of the projections, which overhang them like the eaves of a house, and effectually keep off the rains which fall in such heavy torrents during tropical storms. The material of which these projections are made is the same as that of which the walls of the nest are built, except that it is very much thicker and harder, the various layers being hardly distinguishable, even with a good magnifier.

The interior of the nest is as remarkable as its exterior.

When cut open longitudinally, an operation which was carefully performed by Mr. White, a very curious sight presents itself. The nest is filled with combs, all very much curved, and these curves accommodating themselves beautifully to the general form of the nest. At the top

is a nearly globular mass of brown paper-like substance, which is apparently the nucleus of the nest. The first comb closely surrounds this globular mass, leaving only a small interval between them, so that it forms part of a hollow sphere, and a section of it would present a form like that of the capital letter C laid on its back.

The rest of the combs follow in regular order, the curve of each becoming shallower, until the last is but slightly depressed in the centre. They are carried to the sides of the nest and thereto attached, except in a few places, where an open space is left between the edge of the comb and the side of the nest, so as to allow the wasps to have access to the different tiers of cells. As is the case with most of the wasp tribe, the tiers are single, and the mouths of the combs are all downwards.

The depth of the cells, and consequently the thickness of the combs, varies according to their position in the nest, the upper cells being the largest, and those below the smallest. The longest cells are from five to seven lines in length, and the shortest about two lines. The material of which they are made is the same as that of which the exterior is formed, and is of quite as dark a colour. In texture, however, it is much slighter, being very thin and paper-like. These cells extend to the very edges of the combs, of which there are fourteen in the present specimen. The length of the nest is sixteen inches, and its diameter in the widest part is one foot.

In the upper combs was discovered a quantity of honey, which, when it was found, was hard and dry, of a deep brownish red, and without either taste or scent. De Azara mentions that himself and some of his men ate the honey of the Myrapetra, and that it was of a deleterious character. Another species of honey-making wasp, *Polistes Licheguana*, a native of

Brazil, was discovered by M. St. Hilaire, who mentions that it lays up in the nest a large provision of honey, which is very injurious to mankind, on account of the poisonous plants from which it is taken. *Polistes gallica* also fills its cells with honey, which, however, does not seem to be poisonous.

Within the nest were found also the remains of insects. There was the body of a black fly, which belongs or is allied to the genus *Bibio*, and the remains of a neuropterous insect, which apparently belongs to the genus *Hemerobius*.

The Myrapetra itself is of variable size, the largest being about four lines in length, and rather more than half an inch in expanse of wing. It is of a dusky brown colour, and is remarkable for having the first joint of the abdomen very much lengthened and narrowed, so that it somewhat resembles the same organ in the *Pelopaeus*.

At the left hand of the same illustration may be seen a rather large globular nest, suspended from the boughs. This nest is shown in the position which it usually occupies, namely, hidden in the dark recesses of the Brazilian forest, amid the varied vegetation which grows so profusely in the hot and wet parts of the country which the insect frequents.

The name of the species which makes this nest is *Nectarinia analis*, a title which is significant and appropriate enough, but which is rather unfortunate, inasmuch as it has already been applied to a genus of birds, the well-known honey-suckers of Africa and India, which are so frequently mistaken for humming birds, on account of their small size, their brilliant plumage, their slender beaks, and their fondness for flowers.

This is not nearly so beautiful a nest as that which has just been described, the combs being devoid of regularity, and piled upon each other, as if the insect had no

settled plan on which to work, and put each comb in any place where there happened to be room for it. Irregular, however, as the structure may seem, it is not without a kind of order, for though the combs look as if they had been placed in a heap, and then rolled together, so as to assume a partially spherical shape, they are at all events made with the intention of forming that shape, so that they may be included under a single covering. In the specimen in the British Museum, the outer wall of the nest has been broken away in several places, so as to permit the combs to be seen.

The entrance for the insects is very small, and when the respective dimensions of the wasp and the nest are taken into consideration, it seems really wonderful that when the inhabitants enter their house, they do not lose themselves in the intricate windings through which they pass from one comb to another. The wasp which makes this nest is bee-like in form, and very small, not a quarter of an inch in length, and bearing some resemblance to those tiny solitary bees that are seen so plentifully upon dandelions and various umbelliferous flowers.

The nest is always hung near the ground, quite as low as that of the *Myrapetra*, and is suspended from the slender twigs and long, delicate leaves which are woven into its substance, and in many places pierce completely through the nest, and project through the outer covering. It is, however, destitute of the sharp projections which guard the home of the latter insect, and as the outer wall is both thin and fragile, it would fall an easy prey to any insect-eating animal that might take a fancy to it. I cannot but think that this utterly defenceless state of the *Nectarinia*'s nest affords a proof that the spikes upon the habitation of the *Myrapetra* are not for the purpose of defending the nest against the attacks of enemies.

As is the case with the *Myrapetra*, the cells are made

with walls much firmer than those of our English wasps or hornet, which are only intended to hold successive generations of young, and in consequence are made of a comparatively flimsy material, only strengthened very slightly at the entrance. Were honey to be placed in the cell of any known British wasp it would immediately soak into the walls of the cell, and thence escape by slow degrees, but as the young grub, which is the only tenant of the cell, is without feet and is not in the least formed for locomotion, a very slight partition is sufficient to control its movements.

The grub does nothing but hold to the end of the cell with its piercers, open its mouth for food, and occasionally protrude or withdraw itself in a very slight degree; and its utter immobility in the larval and pupal states affords a strange contrast to the restless and fussy activity which actuates it after it has attained its perfect form.

As is generally known, the nests of wild honey-bees are placed in the hollows of trees. Mr. Cotton, the well-known aparian, remarked, when discussing the comparative merits of straw and wooden hives, that in a state of nature the bee never builds in a truss of straw, but in a hollow tree. Now, although I quite concur with that author in his partiality for the wooden hive, I cannot see that the illustration which he employs has anything to do with the subject, or that it affords the least proof on either side of the argument. Wild bees are not very likely to find trusses of straw in the woods, and those trusses conveniently hollowed to receive them. But I do think that if a few common straw hives were set in the woods, the bees would be as likely to take up their habitation in them as in the hollows of trees.

Still, among honey-bees, of which there are several species, the custom of nesting in hollow trees is almost

universal. Bee-hunters, whether biped or quadruped, whether man, bird, ratel, or bear, search for their sweet spoil in the trees, and know by experience when a tree is likely to contain honey-combs. But in certain parts of tropical America the bees change their habits.

There is a genus of wild honey-bees, named *Trigona*, the members of which are notable for their bold departure from ordinary bee customs. They make their nests at the tops of the branches, it is true, but they do not place their combs inside the hollow trees, of which there is great store in the woods. The *Trigonas* make nests of a pear shape, and of tolerable size, and hang them at the very summit of trees and at the end of the slenderest twigs, so that even the agile monkeys of that land, aided with their long, prehensile tails, are unable to reach the nest.

It is somewhat remarkable that the habit of this insect should be so different from the usual custom, and the more so that a closely allied species, inhabiting the same country, and which possibly belongs to the same genus, makes its nest in trees according to the ordinary type, and places its combs within the hollows of decaying trees. The honey of this bee is described as being very sweet and richly flavoured, so richly, in fact, that very little of it can be taken.

A creature is upon our list of pensile insects, which may also be reckoned among the social or parasitic insects, but which makes its habitation in such a manner that its proper place is among the pensiles. This is the pretty little ichneumon which is known to entomologists as *Microgaster alvearius*. The name *Microgaster* is of Greek origin and signifies "little belly," this being a very appropriate name for this insect, whose abdomen is of very small dimensions, and indeed appears to be just a little supplementary growth which might be removed without causing any inconvenience to the insect. It belongs to

the same genus as a very common insect called *Microgaster glomeratus*, which will be duly described when the parasitic animals are under consideration.

With regard to this insect, I have been rather fortunate, having found many specimens of the nests, and bred from them several hundred insects.

Although plentiful enough in certain places, the BURNET ICHNEUMON, as I shall venture to call this species, is very local, and while abounding in one place may never be seen in another spot at the distance of a very few hundred yards. I give it the popular name of Burnet Ichneumon, for the same reason—comparing great things with small—that Caius Martius bore the title of Coriolanus and Publius Cornelius Scipio was termed Africanus—namely, that it destroys so many Burnet Moths.

In its perfect state the Ichneumon looks like a rather small gnat, and would probably be mistaken for that insect by a non-entomological observer. When examined through an ordinary magnifying glass, it is seen to possess a wondrous beauty which no one could ever suspect when looking at it with the unaided eye. The body and head are of a pale yellow colour, except the prominent compound eyes, which are dark blackish brown. The head is round and rather small, but the thorax is of enormous size, quite as proportionately large as the chest of a man would be did it project some eighteen inches in front and reach to his heels.

In singular contrast to the huge thorax is the very tiny abdomen, which is of a retort shape, curved, and fixed in the upper surface of the thorax by its smaller end. Indeed, the abdomen bears the same relation to the thorax, that the "tick" in the capital letter Q does to the whole of the letter. The limbs are long, and, when the size of the insect is considered, are singularly powerful, especially the last pair of legs. We think the legs of the kangaroo are enormously large in

proportion to the size of its body, but they must be doubled in length as well as in thickness to equal those of the Burnet Ichneumon. The forelimbs are not so very large, but they are long and possessed of great clasping power, aided by the hooked feet.

What, then, is the use of such powerful limbs? The habits of the insect supply the answer.

As is the case with many ichneumon flies, this insect—which, by the way, is not a fly but a near relation to the bee and ant—deposits its eggs upon caterpillars, boring holes in their skin with its pointed ovipositor, which is the analogue of the bee's sting, and inserting its eggs in the perforations. As may naturally be imagined, the caterpillar has a very strong objection to this proceeding, and when the ichneumon settles upon it, and begins to use her weapon, twists and wriggles about like a captured eel.

Now the strong limbs of the ichneumon come into play. Minute as is the insect when compared to the caterpillar, bearing about the same relationship that a rabbit bears to an elephant, the legs are so long that they can include a considerable portion of the skin in their embrace, and so strong that they can retain their hold in spite of the contortions with which the caterpillar tries to rid itself of its persecutor. Retaining her place, therefore, the ichneumon deposits a great number of eggs in the poor caterpillar, and then goes to find another victim.

I am not sure whether or not the ichneumon makes a separate wound for every egg. If so, the feelings of the caterpillar are not to be envied, for I have found nearly a hundred and fifty ichneumon larvae in the body of a single caterpillar. No wonder that the persecuted being endeavours to fling off the creature that is inflicting so many wounds. The numerous short and bristle-like hairs with which the legs are thickly clad, are doubtless useful in retaining the hold of the insect.

The long and slender many-jointed antennæ are also covered with a thick down which has an iridescent effect when the light plays on those organs, and during the life of the insect has a most beautiful effect, owing to the restless, quivering movements which characterise all the antennæ ichneumons, and which at once serve to distinguish those insects at a glance.

The chief beauty, however, of the insect lies in the wings. To the naked eye, they are simply colourless, transparent appendages, with a little black spot on the outer edge of the upper pair. But when placed under a magnifier, and with the light properly directed upon them, they blaze out in iridescent glory that almost fatigues the eye with its resplendence. One of these insects is now under the microscope before me, a low power of only thirty-six diameters being used, so that each wing appears to be about three inches in length, and in order to give an idea of the extraordinary colouring of these apparently transparent organs, I will describe as far as I can the appearance of the right-hand upper wing.

The material of which it is made is a translucent membrane, appearing single with this low power, but shown by a higher power to be double. The wing is traversed by numerous nervures to support it, as the tracery of a Gothic window supports the glass, and which divide it into numerous compartments, technically called cells, each of which is known by name to entomologists. The whole of the membrane is covered with very minute hairs, dotted at regular intervals, like the holes in perforated zinc, and as each of these hairs is in fact a minute prism, they break up the light into the well-known prismatic colours.

Upon the outer edge of the wing is a triangular black spot, which is not transparent, and serves as a foil to show off the lovely colours by which it is surrounded. The whole upper part of the wing is pale yellow, passing, by

the gentlest imaginable transition, through delicate rays into lively pink, of the character termed "rose-carmine." Towards the lower edge of the pink, a slight infusion of blue steals in, being first purple and then changing to azure. Here the colours are abruptly cut by a nervure, and one of the large cells next comes into view. This cell is wonderfully beautiful, for the colours are no longer subdued, as is the case with the upper part of the wing, but are startling from their extreme brilliancy. The circumference of the cell is emerald, enclosing three distinct centres of colouring which seem to divide the cell into three parts. The upper division consists of a large emerald patch, changing in the centre by imperceptible gradations to golden green. Immediately below the green comes a patch of fiery ruby, edged on one side with azure and on the other with golden yellow. The third, or lowermost division, is chiefly blue, edged on one side with ruby and on the other with golden yellow. Thus, we have in this one cell three centres of colour, each centre being one of the three primary colours, and changing by degrees to the secondaries and tertiaries. The next cell is coloured in a similar manner, except that the colours which form the centre of the divisions in the last-mentioned cell form their circumferences in this case; and the base of the wings fades off into delicate shades of pink and rays of golden yellow like the tip.

Now it must be borne in mind that the microscope has nothing to do with the *production* of these colours, but is limited to their exhibition. These wondrous colours already exist, although they are on so small a scale that the unassisted eye fails to separate them, and so they are blended together and appear to be colourless. I mention these apparent platitudes because, while exhibiting the microscope, I have found many persons falling into the error of supposing that the wondrous beauties which they see are due either to

the excellence of the instrument or the skill of the operator.

After the Burnet Ichneumon has laid the eggs she leaves them to be hatched in the animal, which is generally, but not always, the caterpillar of the Burnet moth, itself a pensile insect. This is not always the case, as one of my group of Burnet Ichneumons proceeded from the body of a caterpillar belonging to the geometridæ. It was too much shrivelled for identification, but it was about as large as the larva of the swallow-tailed moth.

In the body of the caterpillar they live until the larval stage is nearly completed, and then they burst on all sides through the skin of their victim, proceed to a small twig and there weave a number of cocoons. These cocoons are about the eighth of an inch in length, cylindrical in shape, set closely side by side and fastened firmly together, so as to form a flattish mass extremely variable in shape and size, the latter depending on the number of cocoons. One of these masses now before me consists of one hundred and seventeen cocoons, and its shape is that of a segment of a circle, fixed to the twig by the flat side.

The ends of the cocoons are both closed, but when the young Ichneumon is hatched it makes its exit by cutting a circular flap from one end of the cocoon, pushing the flap outwards and then creeping into the air. The insects are quite indifferent as to the end of the cocoon through which they escape, and in the example before me nearly two-thirds of the creatures have escaped out of one end and the remaining third out of the other.

The texture of these cocoons is very firm and stiff, and the silken material is so closely fitted together as to be completely waterproof. The microscope shows that the exterior of the cocoon is composed of white silken fibres matted tightly together, and rather rough,

while the inside of the circular flap shows that the interior of each cocoon is smooth, hard, and of a pale yellow hue.

The longest and largest cells occupy the centre of the mass, while those at either end are shorter, smaller, and fewer, being about one-fifth of the entire number. Knowing the customs of most hymenopterous insects, we may conclude that the females occupy the centre and the males the extremities.

Our last example of the pensile nests formed by the hymenoptera is a truly remarkable one. For some time I could scarcely decide upon its place in the present work, whether it was to be ranked as an example of the pensiles, social insects, or builders. On account, however, of the locality which is chosen for it, and the peculiar method by which it is attached to the branch, I have decided upon placing it among the pensile nests.

It has already been mentioned that the members of the genus *Polistes* are in the habit of building their cells in the open air, and leaving them without covering to defend them.

The shape, material, and arrangement of the comb is extremely variable; some, as that which has already been mentioned, hanging their cell-masses to the branches, just as if a number of bee-combs were simply hitched on the twig by the simple process of boring a hole in the upper part of the comb, and pushing the twig through it; others, again, make their cells of mud, in a nearly globular shape, and fasten them on the branches like so many berries. The species, however, which make the cells represented in the illustration, is one of the most remarkable, and so elegant is the form of the combs, and so singular the method of their attachment, that I have had them drawn nearly of the natural size.

Generally, the shape of the comb is nearly round, as

is seen in the upper figure of the illustration. The cells are remarkable for their radiating form, the bases being a trifle smaller than the mouths, a peculiarity which would hardly be noticed in a single cell, but which produces the spreading outline when a number of them are massed together.

Some of the cells, those in the middle, for example, are much longer than the others, and in the specimens in the British Museum many of them are closed at the mouth, showing that the insect is within, and has not yet attained its perfect state. Those on the circumference, however, are much shorter, and are entirely empty, not having been yet occupied. It is very possible that these cells would have been lengthened had the insects been left to themselves.

Although the circular shape is mostly the rule with these combs, so that they look something like withered dahlias or chrysanthemums, it is not the invariable form. If the reader will look at the lower figure in the illustration, he will see that it is much wider than long, and is apparently composed of two of the circular combs fixed together.

Now comes the curious part of the structure. The combs are not fastened directly to the branches, but are attached to footstalks which spring from their centre, and are firmly cemented upon the branch or twig. This group of cells is copied from the specimen in the British Museum, but ought to have been reversed, so that the mouths of the cells hang downwards. The observer should notice the wonderful manner in which the balance is preserved, the footstalk occupying as nearly as possible the centre of gravity.

The footstalks are made of the same papier mâché like substance as the cells, only the layers are so tightly compressed together that they form a hard, solid mass, very much like the little pillars which support the different stories of an ordinary wasp's nest, but of much

greater size. The position of the combs is extremely variable, some being nearly horizontal, and others per-



NESTS OF POLISTES

pendicular, as shown in the illustration. These nests came from Bareilly in the East Indies.

Having now completed our notice of the pensile hymenoptera, we turn to another order of insects.

We can hardly expect to find that any of the beetles can be ranked among the pensile insects, their appearance and general habits being opposed to such an idea. The variety of nests made by the hymenoptera lead us at once to conjecture that some of them may be pensile, for it is at least likely that the little architects which can construct the marvellous system of the honeycomb, or the complicated galleries of the ant's nest, or contrive the wonderful homes of the leaf-cutter bees, would be also able to make nests which could be suspended from leaves or branches. But there is nothing in the general history of beetles which could lead us to place them among the pensile insects, a rank, however, which can be taken by a very few species, most of which belong to a single group.

This group is that of the Weevils, and there are a few species of these long-snouted beetles which make for themselves certain pensile habitations of a most elegant form. Two genera of Weevils are remarkable for the beauty of their cocoons, namely, the *Hypera* and *Cionus*.

If the reader should desire to possess specimens of these cocoons, he cannot do better than procure some seeds of the common species of *Verbascum*, say the Great and White Mulleins, and sow them in sandy or gravelly soil. The beetles of the genus *Cionus* feed on the mulleins, and when they are about to change into the pupal state, do not trouble themselves to leave the plant upon which they have been feeding. So fond are these beetles of the *Verbascum*, that Mr. Stephens found on a solitary plant, which was growing in a garden at Ripley, all the five species of the genus.

During the month of August the larva may be found in the flowers and seeds, and one species burrows into the leaves themselves, getting between the two mem-

branes and feeding on the soft green parenchyma. When the larva are about to enter the pupal state they cease from feeding, and spin for themselves cocoons of a most remarkable shape. The cocoons are very small, being on the average about as large as sweet peas, and nearly as globular. They are constructed of a rather stiff and glutinous thread, which is so wonderfully twined as to form large open meshes of a nearly circular form.

The cocoon is very firm and elastic, feeling and looking very much like those hollow spheres and cylinders that artists in hair are so fond of making. The open meshes are so large that the enclosed pupa can be seen through them, so that there is but little protection from the elements. A very good idea of the general appearance of the cocoon may be obtained from the toys which are made from nuts by neat-handed schoolboys, by the simple process of boring them full of holes until the shell is reduced to a kind of wooden network with circular meshes.

All the beetles of the genus *Cionus* are pretty little creatures, very hard shelled, nearly as globular in form as the cocoon, and marked with dark patches and streaks.

The cocoons of the genus *Hypera* are also made with open meshes, and of a similarly stiff thread, but the form is oval instead of round. The larva of the *Hypera* is long and narrow, having its rings or segments very deeply cut, covered with bristle-like hairs, and having some light lines along the back and sides. The "Charançon de la Patience," of De Geer, is a beetle of this genus. In both cases the cocoons are affixed to the under side of the leaves, whether they are attached to the mullein or the heath, so that they are not readily seen, except by careful observers, who know where to look for them. In the insect room at the British Museum there is a beautiful series of these delicately

formed cocoons, still adhering to the dry and shrivelled leaves of the plant on which the beetle had fed.

We now come to the pensile lepidoptera, of which a number of specimens will be mentioned. They all belong to the moths, the pensile butterflies being content with suspending themselves by a couple of threads, without taking the trouble to build or spin a nest.

One of the most beautiful of these nests is the cocoon of the common EMPEROR MOTH. The moth itself is very beautiful, with its broad, soft-plumaged, pink-eyed wings, but it is even equalled by the larva in beauty of colour, a phenomena not very usual among the lepidoptera. The rings or segments of the caterpillar are rounded and deeply cut, and are remarkable for the tufts of golden-coloured bristles with which they are covered, each tuft springing from a raised and rounded tubercle. The body itself is of a beautiful leaf green.

The cocoon which is made by this remarkable insect is extremely beautiful, though its beauty does not appear to a careless observer. Some twenty years ago, when I first began to study practical entomology, and had no access to the books that were then published on the subject, I took to breeding every caterpillar that could be found, not having the least idea what kind of being would issue from it. Among them was a caterpillar which struck my fancy so much, by its green body and golden tufts, that I made a coloured drawing of it, and constructed for its benefit a separate cage, wherein it lived for some little time, and then spun a silken cocoon of a flask-like shape, very rough and loose on the exterior.

Some time afterwards, upon looking into the box, I saw a beautiful moth clinging to the side. How the creature had gained admission I could not conceive, for the cocoon seemed to be perfectly intact, and to

exhibit no signs that an insect had broken through the walls. Concluding, however, that the moth might have crept into the box without my knowledge, or might have been placed there by some kind friend, I set it, and watched the cocoon as usual. After a whole year had passed, I thought that there must be something wrong, and so took out the cocoon and carefully cut it open.

The mystery was at once explained. Within were the cast shell of the chrysalis, and the dried shrivelled skin of the caterpillar, crushed up into a very small space, but recognisable by the hairy tufts. The manner in which the moth had escaped was also evident. Taking as our model a common Florence oil flask, from which three-fourths of the neck have been removed, we shall obtain a clear notion of the method by which the cocoon is made, so as to allow the egress of the moth, and at the same time to show no aperture through which the creature had emerged.

Let us suppose the material to be stiff, bristle-like hair, and that the body of the flask is made stiff and firm by cementing the hairs together, while they project loosely at the neck. Now, let us further suppose that these projecting hairs are all bent inwards, so as to cross each other slightly, and we shall have a tolerably correct idea of the manner in which the cocoon of the Emperor Moth is made. It will be seen, that if a creature try to push its way out from the inside, the hairs will yield and allow it to pass, but that if any insect tries to push its way in from the outside, the converging hairs are pressed tighter together, and effectually debar it from gaining admission.

This beautiful structure is not visible until the observer strips away a thick, loose coating of yellow-white silk which covers the cocoon, and probably acts as a non-conductor of heat as well as a protection from the weather. This cocoon may be found upon the plant

on which the insect feeds, but the best method of procuring perfect specimens is by searching for the caterpillars and feeding them until they change.

On the right hand of the accompanying illustration may be seen a large moth flying downwards, and just above it are a couple of oval objects attached to a slender bough. This moth is that magnificent insect the ATLAS MOTH, and the oval objects are the cocoons which are spun by its larva.

The Atlas Moth belongs to the same genus as the emperor moth, which has just been described, and is a truly splendid insect, though without the beautiful colours which decorate the emperor. Creamy white, soft yellow, and pale brown are the chief tints of the Atlas Moth, but they are so beautifully blended, the plumage is of so downy a softness, and the expanse of wing is so great, that the Atlas holds its own even amid the more vividly-coloured lepidoptera of its own country.

There are many members of this genus scattered over the different parts of the earth, the finest and largest specimens being found between the tropics. In all the species the antennæ of the males are remarkable for their beauty, being deeply feathered, and shaped something like a spear-head with a triangular blade, and in many examples there is a loose membranous talc-like spot in the middle of the wing.

The cocoons of the Atlas Moth are made of silken thread, much like that of the common silkworm, the cocoon being large in proportion to the size of the moth, and the quantity of silk is necessarily very great. Although the thread is not so fine or glossy as that of the ordinary silkworm, it is strong, smooth, and serviceable, and capable of being woven into fabrics of much utility.

The well-known Eria silk of India is produced by

an insect closely allied to the Atlas Moth. This silk is very loose in texture, and, being without gloss, has



THE HOUSE BUILDER AND ATLAS MOTH

a rather flimsy look. In reality, however, it is possessed of peculiar strength.

One large species of silk-producing moth, also allied to the Atlas, is the *AILANTHUS SILKWORM*. The Acclimatisation Society is endeavouring to introduce this useful insect into this country, and so to make England a silk-producing country. We have not sufficient mulberry-trees to feed silkworms in such numbers as would make their employment profitable, and thus the ordinary silkworm is rather beyond our reach. But the insect in question feeds on the *Ailanthus glandulosus*, a tree which has been imported from China, and thrives wonderfully in the open air. In March 1864, I saw a young sapling about three feet in height that had sprung from a seed sown in March of the previous year.

This insect is very hardy, and after it has been hatched and fed for a little time like the ordinary silkworm, it is laid on the growing leaves and left to shift for itself. The caterpillar is nothing of a wanderer, and does not attempt to straggle from the tree, being content to stay and make its cocoon among the branches. The moth is coloured like the Atlas, being mostly of a greyish yellow, with some markings of dull violet, and some spots of black and white. The caterpillar is green marked with black

We now pass to the second insect represented in the illustration. This is the *HOUSE-BUILDER MOTH*, an insect which is common in many parts of the West Indies, in several places being so plentiful that the sight of its long pendent domiciles is anything but pleasant to the proprietor of a garden.

Out of five species of insects belonging to this singular genus, the present has been selected, because on the whole its habitation is more remarkable than that of any other species. Some of them make their nest in a much stiffer form than is depicted in the engraving, taking pieces of slender twigs and forming them into hollow cylinders, the twigs being laid parallel to each

other, very much like the rods in the old Roman fasces, which were borne by the lictors before the consuls. So close indeed is the resemblance, that by some writers the insects have been called Lictor Moths.

The reader will observe that in the illustration the nest is shown as depending from the caterpillar, part of which protrudes from its mouth and the other part is hidden. This attitude is given because it is that in which the insect is generally seen. While young the caterpillar is so strong, and the house is so light, that it can carry the tail nearly upright.

Scraps of wood mixed with fragments of leaves are the materials which are used, and they are bound together very firmly by the silken threads with which so many caterpillars are endowed, whether they belong to the butterflies or moths. There is a tolerable degree of elasticity about it, especially at the mouth, which is slightly expanded so as to assume an irregular funnel-like shape, and can be drawn together at will by means of the silken threads attached to its circumference. The caterpillar has thus two means of guarding itself from attacks. If it is still clinging to a branch, it can retreat into the house and press the mouth so firmly against the branch that it is closed effectively, just as a limpet shelters its soft body by pressing the top of the shell against the rock. Or, if detached, it can pull the lips together, and thus shut itself up in its strange house as completely as a box tortoise in its shell.

Not only does the creature reside in this nest during its larval condition, but also passes the pupal stage in it, and sometimes the whole of its life. As soon as it ceases from feeding, and is about to become a pupa, it retires far into its cell, shuts up the mouth, throws off its last caterpillar skin, and there remains until the larva has become a perfect insect. Should the moth be of the male sex, it creeps out of the domicile and speedily takes

to wing, employing itself in the great object of its life, that of seeking a mate.

In ordinary cases, to find a mate seems to be no difficult task, but the House-builder Moth has no ordinary obstacles to overcome. The female never leaves her cell, for she would be more helpless as a moth than as a caterpillar. Among the British moths we have several species in which the females are wingless, but at all events they do look like moths which have been deprived of wings, and are able to move about with tolerable freedom. Of these wingless females, the common Vapourer Moth is a familiar example, its fat, rounded abdomen and little truncated rudiments of wings being known to all collectors.

But the female House-builder Moth is as utterly helpless a being as can well be conceived. She has not the least vestige of wings, and but the smallest indications of legs or antennæ. None but an entomologist would take her for a lepidopterous insect, or even for an insect at all, for she looks like a fat, down-covered grub, with very feeble limbs, which can scarcely support the body, and with antennæ that merely consist of a few rounded joints, entirely unlike the beautiful feathered forms which decorate the male.

So utterly unlike a moth is this creature, that our most skilful entomologists are much perplexed as to the position which the insect ought to occupy. Mr. Westwood states that they are "the most imperfect of all lepidopterous insects, and even less favoured than their larva, which they considerably resemble;" while Mr. Newman expresses still stronger opinions, and asserts that the Oiketici ought to be removed from the lepidoptera altogether, and placed with the Phryganeidae, or caddis flies, whose dwellings are wonderfully similar to those of the Oiketici.

The Oriental idea that feminine delicacy is only to be maintained by concealing the face, seems to have been

borrowed from the House-builder Moth, which is a perfect model of female excellence, according to Oriental notions, always staying at home, always hiding her face, and always producing enormous families. Perhaps the male may be attracted to the female by some peculiar instinct, for the eyes can have little to do with the discovery, she being so closely shut up in her house, and never leaving it till the day of her death. Many British insects, such as the well-known Oak-egger Moth, have this curious power, and the male has even been known to enter a pocket in which was a female shut up in a box.

There is an allied genus, named PSYCHE, found in England, the males of which have their wings partly transparent, rather long and sharply pointed, and the females are without wings at all.

The larva of this insect also makes a hollow case, and behaves in a very curious manner before it assumes the pupal condition. First it fastens the mouth of the case firmly to the leaves or branches of the plant on which it has been feeding, and then withdraws itself into the case. Should it be a male larva, it turns completely round, so that its head coincides with the opening at the lower end of the case, through which it makes its escape when fully developed. The female moth, however, behaves like that of the House-builder, and although she also fastens the mouth of her case to the tree, she never leaves her home, and therefore does not need to alter her attitude.

The name of Psyche certainly seems to be misapplied in this instance. In our minds the name of Psyche conveys an idea of the utmost grace and delicacy—two attributes which sculptors and painters have in vain endeavoured to embody. If, therefore, we hear that a certain insect is named Psyche, we certainly expect to see a bright and elegant creature, delicate in form and

pleasing in colour. Whereas, when the domicile is opened, and the real Psyche comes to view, nothing can be more disappointing than the fat, awkward, shapeless grub which has been glorified with such a name.

One of our commonest moths makes a really beautiful pensile nest, though it is hardly appreciated as it should be. I allude to the well-known TIGER MOTH, whose scarlet, white, and brown robes are so familiar to every one who cares for insects, or who happens to possess or take an interest in a garden.

In two of its stages the insect is very common. In the larval condition it is popularly known as the Woolly Bear, in consequence of the coating of long bristle-like hairs with which its body is profusely covered, and which project like the quills of a porcupine, or the spines of a hedgehog, whenever the creature rolls itself up, a movement which it always makes when alarmed. So elastic are the hairs, that the caterpillar may be thrown from a considerable height without suffering any injury, and in all probability their formidable appearance serves to deter foes from meddling with it.

Certain enemies, however, care nothing for this hairy defence, but swallow the caterpillar without hesitation. Chief among these foes is the cuckoo, which feeds largely on the caterpillar of the Tiger Moth, and in consequence is subject to a very remarkable phenomenon. The interior of the gizzard had long been known to be lined with hair, which was thought to be a natural and ordinary growth peculiar to the species. It was, however, discovered—I believe by John Hunter—that these hairs are those of the Tiger Moth, the points of which have worked themselves into the coats of the organ in which they were found. Hunter employs this fact as an illustration of the power and peculiar movement of the gizzard.

Doubts have been thrown upon the accuracy of Hunter's

statement; but the question has been set at rest by two facts. In the first place, cuckoos that have been held in confinement do not possess the hairy lining; and in the second place, the microscope proves that the hairs are those of a caterpillar, allied at least to the Tiger Moth, if not belonging to the insect itself.

When the caterpillar has ceased feeding, and is about to become a pupa, it ascends some convenient object, and then spins a beautiful cocoon, shaped very much like the grass hammocks made by the natives of tropical America, and bearing a considerable resemblance to them in general form, as well as in the loose and open meshes. So long, indeed, are the meshes made, that the enclosed insect can be seen through the network, from the time that the old wrinkled skin is cast off and pushed away in a heap by the white and shining chrysalis, to the time when the chrysalis shell is in its turn shattered, and the perfect moth creeps slowly into the air, all dull, and sodden, and bewildered, with its undeveloped wings looking like four mottled split peas rather than the beautiful members which they soon become, when the air has passed into their vessels, and their multitudinous folds have been shaken out.

I hope that none of my readers will kill a Tiger Moth in either of its stages. It does no harm to the gardener, and has quite enough foes of its own; the ichneumon flies piercing it in spite of its long bristles, and the cuckoo, together with other birds, revelling in so large and juicy a morsel. It is a special favourite of mine, this great moth, for I have kept so many hundreds of them, and have admired the wondrous details of their anatomy so often, that I am always glad to say a kind word for a creature which has afforded me so much amusement and instruction.

Among the pensile insects may be reckoned the beautiful BURNET MOTH, an insect which has already

been mentioned while treating of the pensile hymenoptera.

This insect, which is well known for its splendid colours of deep velvet green and blazing scarlet, is also notable for the shape of its antennæ, which are so swollen towards the tips as to induce many persons to reckon the insect as a butterfly rather than a moth.

The shape of the cocoon of the Burnet Moth is not unlike that of the Tiger Moth, but its material and position are very different. The cocoon of the Tiger Moth is slung horizontally, in hammock fashion, while that of the Burnet is set perpendicularly, and fastened to the upper part of a grass stem, one side being firmly pressed against it. The substance of the cocoon is quite opaque, greyish, rather stout, very tough, and having the silken threads, of which it is chiefly made, so conspicuous, that many persons take the cocoon to be the work of a spider.

Sometimes in a field, or even in a limited portion of a field, these cocoons are so numerous that at a little distance they look almost as if they were the seeds of the plant rather than the cocoons of an insect. In such cases the moths themselves may generally be found near the cocoons, sometimes being on the ground and sometimes on the wing. These moths are peculiarly liable to the attacks of the ichneumon flies, for not only does the Burnet ichneumon make them its special prey, but I have seen a large percentage of the cocoons bored full of holes, which show that one of the parasitic hymenopteras has laid its eggs in the caterpillar, that the young have been developed, and made their escape to continue the work of destruction, and that the caterpillar which nurtured them is lying dead within its useless cocoon.

There are others of our finest and yet commonest moths which make to themselves pensile habitations in

which they pass the long time of helplessness when they are in the pupal state. Anything more utterly helpless than the pupa of certain moths cannot well be imagined, their only protection consisting either in their hiding-place or the sheltering armour in which the creature is enveloped.

The fur-clad DRINKER MOTH, for example, spins a cocoon which bears some resemblance in its texture to that of the Burnet Moth, though it is rather looser in structure and is of much larger dimensions. The general colour of the cocoon is grey, with a few brownish mottlings here and there, and in form it is spindle-shaped, being widest in the centre, and diminishing to a point at either extremity. Conspicuous as this cocoon appears to be when exhibited in a glass case, it is anything but conspicuous in the position wherein it is placed by the insect. I have bred at least two hundred moths from the caterpillar, and though the space was necessarily limited, many of the cocoons escaped observation until after the moth had been developed and made its escape.

Like the Burnet Moth, the Drinker is very liable to the attacks of ichneumons. There is now before me a cocoon which was made in 1846, and is preserved as one of the first instances of an entomologist's disappointment. As it now lies on its slab of white cardboard, it looks as if a charge of dust-shot had been fired through it, no less than seventeen minute holes being perceptible on one side alone, each hole representing at least one ichneumon fly which had made its escape after fulfilling its destructive mission.

The handsome OAK-EGGER MOTH affords another example of the pensile cocoon. Of these insects also I have had great numbers; and some specimens of the moth, chrysalis, and cocoon are now before me, the cocoon unchanged by the eighteen years which have

elapsed since it was made, but the moth sadly faded, after the manner of its kind when exposed to the action of light. This insect, by the way, is one of those which suffer the most from the fumes of sulphur, a lesson which I long ago learned from experience. Having been told that the best method of killing moths was to expose them to the fumes of burning sulphur, I invented an apparatus which would cause the insects to be enveloped in dense fumes, while the heat of the burning sulphur was carried off in another direction.

Of its efficacy as a means of destruction no complaint can be made, inasmuch as it destroyed the insect in a very few moments: but as it likewise discharged the colours, its use was soon given up. All the beautiful scarlets lost their tone, and became pale orange, and in the case of the Oak-Egger and similar moths, the warm dun of the wings changed to dirty yellow. Moreover, the sublimated sulphur was sure to rest upon the wings, and to destroy their delicacy.

Camphor, which is so largely and so wrongly used in cabinets, is liable to the same objection. Its volatility is extreme, a large lump vanishing in a wonderfully short time when exposed to the air. The pieces of camphor used in cabinets continually need renewal, and the question frequently arises, Where has the camphor gone? The answer may be found in the dimmed glass, on which a deposit has been left, and which is so difficult to be cleaned, as well as on the enclosed insects, the lustre of whose bodies is sadly marred by the same substance.

Large as is the caterpillar of the Oak-Egger Moth, it is contracted into a comparatively small chrysalis when it assumes the pupal state, and makes a cocoon which only allows enough space for the pupa and the cast larval skin. The form of the cocoon is egg-shaped, whence the name of Oak-Egger, and its substance is rather peculiar, being thin, hard, and rather brittle

when quite dry. Externally it is surrounded by a loose layer of silken threads, by means of which it is attached to the plant on which it hangs; but the cocoon itself is smooth, very much the colour of half-charred paper, and in spite of its brittleness is possessed of some elasticity.

The manner in which the insect packs itself in so narrow a cell is most ingenious, and a cocoon may well be sacrificed in order to show the method by which this feat is achieved. If a cocoon be opened longitudinally, the chrysalis will be seen to fill the whole of the interior. On examining it more closely, the cast skin is seen to envelop the whole abdomen of the pupa, being pushed down in folds so as to fit closely round the pointed abdomen, and to occupy as little space as possible.

When the moth escapes from the cocoon, it breaks away quite a large hole at the end next the head, and slips out of the chrysalis shell with great ease, by lifting up a large flap which covers the legs and the head, and which gives way at the line of demarcation which separates it from the wings. In consequence of this arrangement, the pupa shell and the cast caterpillar skin remain in exactly the same position, and by means of a little ingenuity the raised flap can be replaced and fastened so as to give no indications that the insect has ever broken it. These cocoons are far more conspicuous than those of the Drinker Moth, and are attached rather lightly to the stems of various plants.

There is a smaller insect, popularly called the LITTLE EGGER MOTH, which spins a cocoon of a similar structure, except that the walls are of even harder and more uniform texture, scarcely larger than a wren's egg, and of a substance which looks almost as if it were made of the same material as the egg. When broken, it is found to be even more brittle than that of the larger insect. Owing, in all probability, to the exceeding closeness of

the structure, which would exclude air from the inhabitant, it is perforated with one or two very tiny and very circular holes, which look just as if some one had been trying to kill the insect by piercing the cocoon with a fine needle or pin.

Even from the outside these perforations are visible, but they are much more evident when the cocoon is opened. The object of these holes is, however, conjectural, and it would be a useful experiment to stop them with wax, in order to see whether the enclosed insect could be developed when the air was thus excluded I believe that there are none of these holes in the cocoon of the large Oak-Egger Moth, and if there be any such perforations, they are so minute as to escape notice.

If the reader will refer to page 112, he will see an account of certain cocoons which are made by hymenopterous insects, and suspended by a single thread from the branches

In Mr. H. W. Bates's work on the natural history of the Amazon River, there is a most interesting account of a pensile cocoon also suspended by a single thread, but which is the work of a lepidopterous insect. It will be seen that Mr. Bates was able to see the insects spin the cocoon, and his account exactly tallies with Mr. Westwood's conjecture as to the method by which the creature manages to produce a hollow cocoon at the end of a single thread Mr. Bates's account is as follows:—

"The first that may be mentioned is one of the most beautiful examples of insect workmanship I ever saw. It is a cocoon, about the size of a sparrow's egg, woven by a caterpillar in broad meshes, of either buff or rose-coloured silk, and is frequently seen in the narrow alleys of the forest, suspended from the extreme tip of an outstanding leaf by a strong silken thread, five or six

inches in length. It forms a very conspicuous object, hanging thus in mid-air. The glossy threads with which it is knitted are stout, and the structure is therefore not liable to be torn by the beaks of insectivorous birds, while its pendulous position makes it doubly secure against their attacks, the apparatus giving way when they peck at it. There is a small orifice at each end of the egg-shaped bag, to admit of the escape of the moth, when it changes from the little chrysalis which sleeps tranquilly in its airy cage. The moth is of a dull slaty colour, and belongs to the *Lithosiidae* group of the silk-worm family.

"When the caterpillar begins its work, it lets itself down from the tip of the leaf which it has chosen, by spinning a thread of silk, the thickness of which it slowly increases as it descends. Having given the proper length to the cord, it proceeds to weave its elegant bag, placing itself in the centre, and spinning rings of silk at regular intervals, connecting them at the same time by means of the loose thread; so that the whole, when finished, forms a loose web, with quadrangular meshes of nearly equal size throughout. The task occupies about four days: when finished, the enclosed caterpillar becomes sluggish, its skin shrivels and cracks, and there then remains a motionless chrysalis of narrow shape, leaning against the sides of its silken cage."

Some other lepidopterous insects suspend themselves by single threads, but most of them make their habitations of leaves, so that when suspended, they do not attract much attention, looking like chance leaves that have fallen from the branches and caught in a stray piece of spider's web. Sometimes these nests are made from single leaves, the edges of which are drawn together by the silken threads spun by the caterpillar that takes refuge within, and sometimes they are made from several leaves, which are fastened to each other

by similar threads. Some of these pensile nests are inhabited by a number of caterpillars, which live together in perfect harmony. Such nests are not uncommon in tropical countries, and one traveller describes some of these nests by comparing them to the white paper bags in which grapes are tied when ripe, in order to preserve them from wasps and other marauders.

He also mentions that the interior contained a quantity of green leaves, which afforded food to the inhabitants, but does not tell us whether the leaves were actually growing on the tree and surrounded by the nest, or whether they had been cut from the boughs outside, and carried into the interior by the inhabitants. The latter supposition is implied, but it can hardly be a correct one, as it is directly contrary to our present knowledge of the habits of caterpillars. I believe that no lepidopterous larva is known to fetch food from a distance, and to store it for future consumption. As far as we know at present, the caterpillar has not the least thought for the morrow, but simply devours the leaves where they grow.

There are many species, such as the larva of the common BROWN-TAIL MOTH, or of the SMALL ERMINE MOTH, which travel by day to considerable distances in their search after food, and return at night to their common habitation, guided by the threads which they continually spin as they crawl along. But no caterpillar is known which is gifted with the instinct of cutting off leaves and bringing them home for food, and we may therefore infer that the leaves in question were growing on the branches, and that the nests had been purposely spun round them.

There are, however, one or two species of British insects belonging to the lepidoptera, which do cut off leaves and use them for the construction of the cocoon, though they do not employ them for food. These

insects are moths, belonging to the genus *Acronycta*, and popularly called SPURGE MOTHS on account of the plant on which they reside. One of these species makes a really curious pensile cocoon from the leaves of the cypress spurge, rather a scarce perennial plant about a foot in height, growing about woods and the borders of the fields. The leaves of the stem are lance-shaped, and those of the branches almost linear, like grass blades, and it is of these latter that the insect makes its habitation.

About October, the caterpillar begins to make its house, and does so in a very curious manner. Detaching a leaf from a branch, it fastens one end to the stem, and then bends the leaf so as to form a loop, and fastens the other end in a similar manner. A number of the leaves are placed nearly parallel to each other, so that when they are firmly woven together they form a bag-like cocoon, fixed to the stem of the plant by one side, and being upright like that of the Burnet Moth. Its texture is, however, very unlike that of the Burnet, being loose, almost wholly composed of vegetable matter, and comparatively flimsy.

It has well been remarked that the strength, or at all events, the weather-resisting power, of a cocoon depends upon the length of time which is occupied by the insect in undergoing its transformation, those creatures which only spend a few weeks in the pupal state being content with a mere web or hammock of silk, while those which pass the winter in the pupal condition make habitations which are comparatively substantial.

This rule, however, is not without its exceptions, as we find the pupæ of several butterflies, the common cabbage butterfly, for example, merely hung against walls, &c., without any protection around them. Instinct leads them to choose such spots as can best afford them shelter, as every one knows who has a tool-house

or a summer-house in the garden, but there are many cases in which no such protection can be found, and the insects are forced to content themselves with the southern side of a tree trunk, or the least windy side of a paling.

The caterpillar of the Spurge Moth is rather prettily marked, being striped longitudinally with white, red, and brown, relieved with black, and furnished with some scanty tufts of hair on each segment.

We now pass to the enormous variety of caterpillars which are popularly called Leaf-rollers, because they make their homes in leaves which they curl up in various methods.

Some use a single leaf, and others employ two or more in the construction of their nests. Even the single-leaf insects display a wonderful variety in their modes of performing an apparently simple task. Some bend the leaf longitudinally, and merely fasten the two edges together, while others bend it transversely, fixing the point to the middle nervure. Some roll it longitudinally, so as to make a hollow cylinder corresponding with the entire length of the leaf, while others roll it transversely, so that the cylinder is only as long as the leaf is wide, and a few species cut a slit in the leaf and roll up only a small portion of it.

The Leaf-roller caterpillars belong to numerous species, and are plentiful enough, too plentiful indeed to please the gardener, who finds the leaves of his favourite trees curled up and permanently disfigured by these little marauders. All of them are of small size, and some so minute that the mere fact of their ability to roll up a leaf is something wonderful.

They flourish best during mild and rather rainy seasons, because the leaves are charged with moisture, and are so soft that they can easily be rolled, and moreover, contain a plentiful supply of food. During the

present year, 1864, the Leaf-rollers have suffered greatly, the continual drought having dried up the leaves, rendering them both stiff and innutritious. The lilacs in my garden, which are usually covered with these cylindrical nests of Leaf-roller caterpillars, are comparatively free from them, and the few which exist are very poor specimens, several having been abandoned in a half-made state. In the lilacs of a friend, however, where the soil is about one hundred and twenty feet lower than my own garden, there are plenty of Leaf-roller nests, the ground being much moister than in more elevated situations, and being, moreover, on a different soil.

The mechanics of the Leaf-roller nest are very curious, and will be presently mentioned.

One of the most common among the Leaf-rollers is the pretty OAK MOTH, which must not be confounded with the Oak-Egger Moth already mentioned. It is a little creature, with four rather wide delicate wings, the upper pair of a soft leaf green, and the under pair of a greyish hue. In some seasons, the moths, or rather their larvae, are so plentiful that great damage is done to the oak forests, tree after tree being so covered with them that scarcely a leaf escapes destruction, and the growth of the tree is consequently checked.

Like all Leaf-rollers, they feed on the green substance of the leaf, and being ensconced within their tubular home can eat without fear of molestation. They are not very much afraid even of the small birds, for as soon as a bill is pushed into one end of the leafy cylinder, the caterpillar hastily "bundles" out of the other—there is no other word which so fully expresses the peculiar action of the larva—and lowers itself towards the ground by a silken thread which proceeds from its mouth. In fact, it acts like a spider in similar circumstances.

Where these insects are plentiful, an absurd effect can be produced by tapping the branches of oak trees with a stick. As the stroke reverberates through the branch, the leaves, which appear to the casual passenger to be in their ordinary condition, give forth their inhabitants, and hundreds of tiny caterpillars descend in hot haste, each lowering itself by a thread and dropping in little jerks of an inch or two each. Some of them are more timid than the others, and descend nearly to the ground, but the general mass of them remains at about the same height. Another tap will cause them all to drop a foot or two lower, the stroke being felt even at the end of the suspending thread, and by administering a succession of such taps they will all be induced to come to the ground. There they will wait a considerable time, but presently one of them will begin to re-ascend, working its way upwards along the slender and scarcely visible line as easily as if it were crawling upon level ground. The least alarm will cause them to drop again, for they are then very timid, but if allowed to remain in peace, they speedily reach their cells and enter them with a haste that very much resembles the quick jerk with which a soldier-crab enters the shell from which he has been ejected.

If a tolerably smart breeze be blowing, the sight is still more curious, for the caterpillars are swung about through very large arcs, and, if the wind be steady, are all blown in one direction, so that their line forms quite a large angle with the level of the leaf to which the upper end is attached. The caterpillars, however, seem to be quite indifferent in the matter, and ascend steadily, whether the line be simply perpendicular, or whether it be violently blown about by the wind.

At the proper season of year, the moths are as plentiful as the larvae, and a shake with the hand will cause a whole cloud of the green creatures to issue forth,

producing a strangely confused effect to the eye as they flutter about with an uncertain and devious flight. A sweep with an ordinary entomological net will capture plenty of them, but in a few minutes they all disappear, some of them returning to the branches whence they had come, and others dropping to the ground. During the summer of 1864 they were very plentiful in Darenth Wood, the heavy growth of oaks giving them every encouragement.

The insect which commits such devastation on the lilacs is generally the little chocolate-coloured moth called the LILAC MOTH, though there are other allied species which infest the same plant. Any one may see the damaged leaves for himself, and therefore I shall not particularly describe them, but pass at once to the mechanical powers which are involved in the task of curling the elastic leaf into cylindrical form.

Compare the size of the lilac leaf and of the newly hatched caterpillar, the latter being about as large as the capital letter I. That so minute a creature should roll up the leaf by main strength is of course an impossibility, and the method by which that consummation is attained is so remarkable an instance of practical mechanics that I must describe the operation at length.

If the reader will procure one of the rolled leaves, he will see that the cylindrical portion is retained in its place by a row of silken threads, which are individually weak, but collectively strong, holding the elastic leaf as firmly as Gulliver was held by the multitudinous cords with which he was fastened to the ground. That they should hold the cylinder in shape is to be expected, but the manner in which the cylinder is made is not so clear. The following is the process:—

First, the caterpillar attaches a number of threads to the point and upper edges of the leaf, and fastens

the other ends to the middle of the leaf itself. It now proceeds to perform an operation which is precisely similar to the nautical method of "bowsing" up a rope. In order to "bowse" a rope taut, two men are employed, one of them pulling the nearly tightened rope at right angles so as to bend it, while the other continually belays it to the cleats. Now, the caterpillar performs precisely this operation, but without requiring the aid of an assistant, the "browsing" being performed by its feet, and the belaying by its spinneret. By thus hauling at, and tightening each line in succession, the caterpillar bends the leaf over slightly, and then attaches a fresh series of threads to keep it in its place. By repeating this process, and by continually adding fresh lines, the creature fairly bends the leaf into a hollow cylinder, and then crawls inside to enjoy its well-earned home.

I may here point out that the whole process of rolling the leaf affords an admirable example of mechanics as exhibited in nature, and that it is achieved by the well-known principle of exchanging space and time for power. Although the caterpillar cannot by any exertion of strength roll up the leaf in one minute, it is enabled to do so by dividing the work into a multitude of parts, and taking much longer time about it, just as a man who cannot lift a single weight of a thousand pounds may do so with ease by dividing it into ten parts, and in consequence, by taking up a considerable time in lifting the separate parts.

Again, in the silken bands which hold the rolled and elastic leaf in its place, we have an excellent example of accumulated power; neither of the threads being alone capable of enduring the tension, but their united strength being more than sufficient for the task.

As soon as the caterpillar has entered its new home, it begins to feed, eating the green substance of the leaf, and generally leaving the nervures untouched. Sometimes the caterpillar lives for so short a time that a single

leaf is sufficient for its subsistence; but there are some species which are obliged to repeat the task more than once.

There are other insects which also make their habitations in leaves; but instead of rolling up the leaf and living inside the cylinder, they make their way between the two membranes, and there remain until they have undergone their transformation.

The reader must often have seen the leaves of garden plants and trees, especially those of the rose, traversed by pale winding marks, that look something like the rivers upon a map, and having mostly a narrow dark line running exactly along the middle. These curious marks are the tracks which are made by the various leaf-mining insects, while eating their way through the leaf in which they pass their larval state. In most cases, when the insect has completed its term of larval existence, one end of the track is found to be greatly widened, and to contain either the pupa itself or its empty case.

The track differs considerably in shape, according to the insect which makes it. Sometimes it winds about in the middle of the leaf, crossing itself more than once in its progress. Sometimes it proceeds in a nearly straight line across the leaf, and very frequently, especially in deeply-cut leaves, it follows the outline, keeping to the edge, and not trenching at all on the central portions.

Insects belonging to three orders are known to make these curious habitations—namely, the Lepidoptera, the Coleoptera, and the Diptera. Of these, the Lepidoptera are by far the most numerous, and belong to that group which is called, on account of their very minute dimensions, the Micro-Lepidoptera. These are all little moths, so small that on the wing they can scarcely be recognised as moths, and look more like little flies. They are all

very beautiful, and many of the species are truly magnificent when seen through a microscope, their plumage glittering as if made of burnished gold and silver. Indeed, one genus in which these leaf-miners are comprised, is named *Argyromiges*, a title based on a Greek word signifying silver.

The species which is most common in the leaves of the rose-tree is the RED-HEADED PIGMY. The larva of this insect seems not to possess even the rudiments of legs, and forces itself through the leaf by means of certain projections of the skin, which are sharp and angular, and serve as instruments of progression, like the abdominal scales of the serpent and the bristles of the earthworm. A species which is found in the leaf of the oak is known to collectors by the name of CRAMER'S PIGMY. The caterpillars of the DAGGER MOTH also live between the membranes of leaves, and are remarkable for the last pair of feet, which are shaped like a couple of very minute battledores. These feet are spread out greatly in the act of walking, and the creature is further aided in its progress by the hair-covered warts upon the body.

As for the beetle leaf-miners, they are to be found among the weevils; and it is a remarkable fact that one of these insects belongs to the genus *Cionus*, which is the weaver of certain beautiful pensile cocoons.

Of the Diptera, the CELERY FLY is a good example. The larva of this really pretty fly, with its green eyes and black and white spotted wings, feeds not only on the celery but on the parsnip, and does great harm to both plants. Gardeners often employ little boys to examine the celery plants, and whenever they find a "blister," as they technically call it, to crush the enclosed maggot between the fingers. The colour of this larva is pale green, so that it is not readily seen even when the blister is opened. If allowed to have its own way, the larva remains in the leaf until it has

finished its eating, and then descends into the ground, where it changes into the pupal state, and remains until the following spring. In such a case, the leaves are often much damaged, the blisters being yellowish white, and the leaf itself drooping and half withered.

Our last examples of pensile nests are taken from the Arachnida, being formed by several species of spiders.

It may perhaps be necessary to remark that the threads with which the spiders make their webs are in some respects similar to those which are produced by various caterpillars, and in other respects are exceedingly dissimilar. In both cases, the threads are formed from a semi-liquid secretion, which is produced in the internal organs, is forced through minute apertures at the will of the animal, and hardens into a thread as soon as it comes in contact with the air.

Here, however, the resemblance ceases. The threads of the caterpillar are double, or rather are composed of two lines fused together throughout their length, the two half-lines proceeding from a large silk-secreting tube at either side of the body, and uniting at the mouth, where they become fused together by passing through a short tube common to both. The threads of the spider are much more complex, each being formed of a vast number of smaller lines, which are produced from a peculiar organ termed the "spinneret," which is placed at the extremity of the body. In consequence of its position, the spider always hangs with its head downwards while lowering itself by means of its line.

The spinnerets are externally like little rounded projections, arranged in pairs, and four, six, or eight in number. They are variable in shape, mostly being rounded, but sometimes being so long that they have been mistaken for feelers. The spinnerets are covered

with a multitude of very minute hair-like appendages, which are, in fact, the tubes through which the liquid secretion is forced into the air. All the threads which proceed from these tubes are joined into a single line; and it will be at once seen that very great strength is obtained by making the line compound instead of single.

The best known of these creatures is the common GARDEN SPIDER, sometimes called the GEOMETRIC SPIDER, whose beautifully radiated nest is so familiar that its general shape requires no description. Suffice it to say, that the spider exhibits wonderful skill in placing its web, making a framework of very strong threads or ropes, and then spinning the net itself between them. Very great elasticity is thus obtained, for the threads are exceedingly elastic; so that, although stretched tolerably tightly, they will yield to pressure, and immediately recover themselves. This property is very needful, in order to enable them to resist the wind, to which they are so fully exposed.

These spiders have, moreover, a most singular plan of strengthening their web, when the wind is more than ordinarily violent. If they find that the wind stretches their nets to a dangerous extent, they hang pieces of wood, or stone, or other substances to the web, so as to obtain the needful steadiness. I have seen a piece of wood which had been thus used by a Garden Spider, and which was some two inches in length and thicker than an ordinary drawing-pencil. The spider hauled it to a height of nearly five feet; and when by some accident the suspending thread was broken, the little creature immediately lowered itself to the ground, attached a fresh thread, ascended again to the web, and hauled the piece of wood after it.

It found this balance-weight at some distance from the web, and certainly must have dragged it for a distance of five feet along the ground before reaching

the spot below the web. There were eight or ten similar webs in the same verandah, but only in the single instance was the net steadied by a weight.

The structure of the beautiful web is very remarkable.

It is nearly circular, and is composed of a number of straight lines, radiating from a common centre, and having a spiral line wound regularly upon them. Now, the structure of the radiating and the spiral lines is quite distinct, as may be seen by applying a microscope of moderate power. The radiating lines are smooth and not very elastic, whereas the spiral line is thickly studded with minute knobs, and is elastic to a wonderful degree, reminding the observer of a thread of indiarubber. So elastic, indeed, is this line, that many observers have thought that the spider has the power of retracting them within the spinnerets, inasmuch as she often will draw a thread out to a considerable length, and then, when she approaches the point to which it will be attached, it seems to re-enter the spinneret until it is shortened to the required length. This, however, is only an optical delusion, and caused by the great elasticity of the thread, which can accommodate itself to the space which it is required to cross.

It is to the little projections that the efficacy of the net is due, for they are composed of a thick, adhesive, and viscid substance, and serve to arrest the wings and legs of the insects that happen to touch the net. In his splendid work on the British Spiders, Mr Blackwell has the following remarks upon the structure of the threads:—"As the radii are unadhesive, and possess only a moderate share of elasticity, they must consist of a different material from that of the viscid spiral line, which is elastic in an extraordinary degree. Now, the viscosity of this line may be shown to depend entirely upon the globules with which it is studded, for if they be removed by careful application of the

finger, a fine glossy filament remains, which is highly elastic, but perfectly unadhesive. As the globules, therefore, and the line on which they are disposed, differ so essentially from each other and from the radii, it is reasonable to infer that the physical constitution of these several portions of the net must be dissimilar.

"An estimate of the number of viscid globules distributed on the elastic spiral line in a net of *Epeira apocissa* of a medium size, will convey some idea of the elaborate operations performed by the *Epeira* in the construction of their snares. The mean distance between two adjacent radii in a net of this species, is about seven-tenths of an inch; if therefore the number seven be multiplied by twenty, the mean number of viscid globules which occur on one-tenth of an inch of the elastic spiral line, at the ordinary degree of tension, the product will be 140, the mean number of globules deposited on seven-tenths of an inch of the elastic spiral line. This product multiplied by twenty-four, the mean number of circumvolutions described by the elastic spiral line, gives 3360, the mean number of globules contained between two radii; which, multiplied by twenty-six, the mean number of radii, produces 87,360, the total number of viscid globules in a finished net of average dimensions.

"A large net, fourteen or sixteen inches in diameter, will be found by a similar calculation to contain upwards of 120,000 viscid globules, and yet *Epeira apocissa* will complete its snare in about forty minutes if it meet with no interruption."

These calculations will serve to show the elaborate nature of the webs which we see constantly in our gardens, as well as their value to the architect. The secretion of the liquid from which the lines proceed is a work of time, so that if a spider is forced to spin several nets in rapid succession, it loses all its silk and cannot make a web. To wait until a fresh supply should be

secreted would be a terrible privation, and moreover, the want of food would stop the secretion, so that the spider has no other resource than to make war on a weaker spider, drive him out of his net, and usurp possession thereof. Such being the case, the spiders are all very chary of using their silk, and never trouble themselves to make webs when a storm is impending. They are therefore very excellent barometers; and if the spiders all take to mending their nets or spinning new webs, fine weather is always at hand.

One very remarkable point in the construction of these webs, so exactly true in all their proportions, is that they are executed entirely by the sense of touch. The eyes are situated on the front of the body and on the upper surface, whereas the spinnerets are placed at the very extremity of the body and on the under surface, the threads being always guided by one of the hind legs, as may be seen by watching a garden spider in the act of building or repairing her web. In order that the fact should be placed beyond a doubt, spiders have been confined in total darkness, and yet have spun webs which were as true and as perfect as those which are made in daylight.

A peculiarly beautiful pensile cocoon is constructed by a common British spider, which has no popular name. It is really remarkable that, considering the great number of species which inhabit England, so very few should have been sufficiently distinguished to receive popular names. Owing, in all probability, to the foolish dislike towards spiders entertained by most persons, a dislike which has been instilled into their minds at a very early age, these wonderful and interesting creatures are seldom watched, and there are very few persons who really know one spider from another, or who have any idea of their exceeding usefulness when in the places which they were intended to inhabit. Spiders are certainly out

of their place in a room, and the housemaid is perfectly justified in exterminating them, but in the garden or the field they should never be injured, but rather encouraged as much as possible.

The species whose beautiful nest will now be described is generally to be found upon commons, especially where gorse is abundant, as it generally hangs its nest to the prickly leaves of that shrub. The cocoon is shaped rather like a wine glass, and is always hung with the mouth downwards, being fastened by the stalk to a leaf or twig of the gorse. It is very small, only measuring a quarter of an inch in diameter, and when it is first made, is of the purest white, so as to be plainly visible among the leaves.

This purity, however, it retains but a very short time, for after the spider has deposited her eggs, which are quite spherical, and about forty or fifty in number, she closes the mouth of the cocoon and proceeds to daub it all over with mud. The moistened earth clings tightly to the silken cocoon, and disguises it so effectually that no one who had not seen it before that operation could conceive how beautiful it had once been. The muddy cover certainly makes the cocoon less visible, and may probably have another effect, that of protecting the enclosed eggs and young from the attacks of insects that feed upon spiders. Several other species have the habit of daubing their beautiful cocoons with mud.

This species is plentiful in Bostal Common and Bexley Heath in Kent, the profuse growth of gorse being very suitable to its mode of life, and I have several specimens of their nests taken from Shooter's Hill. June is the best month for them, as they may be found both before and after the mud has been applied.

An allied species is equally plentiful in similar localities, where its curious webs may be seen stretched in horizontal sheets over the gorse, and having attached to each web a cylindrical tube, at the end of which

sits the spider itself. Heath and common grass are also frequented by this spider.

Besides the net or web in which it lives, and by means of which it catches prey, it makes a beautiful cocoon in which the eggs are placed. Externally the cocoon looks like a simple silken bag, perfectly white in colour, and, except in size, somewhat resembling that of the preceding species. It is only when quite freshly made that the white hue of the cocoon is visible; for after its completion, it is covered with scraps of dry leaves, bark, earth, and other substances. If, however, this cocoon be opened, it is found to contain at least another cocoon within, and often comprises two, of a saucer-like shape, and made also of white silk. These inner cocoons are nearly half an inch in diameter, and contain a very variable quantity of pale yellow, spherical eggs, sometimes fifty in number, but often exceeding a hundred. The inner cocoons are firmly tied by strong lines to the interior of the large sac in which they are enclosed.

## CHAPTER VI.

*BUILDERS.*

Building Mammalia—Definition of the title—Inferiority of the mammalia as architects—The BRUSH-TAILED BETTONG—Its structure and colour—The nest of the Bettong, and its adaptation to the locality—Singular method of conveying materials—Its nocturnal habits—The RABBIT-EARED BANDICOOT, and its habitat—The generic title—Curious form of the ears and feet—Difficulty in discovering its nest—The MUSQUASH or ONDATRA—Its general habits—Its burrowing powers, and extent of its tunnels—The Musquash as a builder—Form and size of its house—Mode of killing the animal by spear, gun, and trap—Its flesh and fur

WE now take our leave of the Pensiles, and pass to those animals which build, rather than burrow or weave. The materials used by the Builders are variable. In the most perfect examples, earth is the material that is employed, but in many instances other substances, such as wood, earth, and sticks, are used by the architect.

As a general rule, the mammalia are by no means notable for their skill in the construction of their houses. In making burrows they far excel all the other vertebrates both in the length of the tunnels and in the elaborate arrangement of the subterranean domicile. The mole, for example, is pre-eminent as a burrower and as a subterranean architect, and there are many of the rodents which drive a whole labyrinth of tunnels through the soil. But they are very indifferent builders, and

with a few exceptions are unable to raise an edifice of any kind, or to weave a nest that deserves the name.

Our list of Building Mammalia will therefore be a short one, comprising only three species, two inhabiting Australia, and one a native of America.

The first example of the Building Mammalia is the PENCILLED BETTONG, sometimes called the BRUSH-TAILED BETTONG, and often known by the name of JERBOA KANGAROO. The word Bettong is a native name for a group of small kangaroos that are easily recognised by the shape of their heads, which are peculiarly short, thick, and round, and very unlike the long deer-like head of the larger kangaroos.

The Brush-tailed Bettong is about as large as a hare, and its tail is not quite a foot in length, though it appears longer in consequence of a brush-like tuft of long hair which decorates the end. It is a pretty creature, elegant in shape, extremely active, and the white pencilings on the brown back, the grey-white belly, and the jetty tuft on the tail are in beautiful contrast to each other.

The home of this animal is a kind of compromise between a burrow and a house, being partly sunk below the surface of the ground and partly built above it. The localities wherein the Bettong is found are large grassy hills whereon there is hardly any cover, and where the presence of a nest large enough to contain the animal, and yet small enough to escape observation, appears to be almost impossible. The Bettong, however, sets about its task by examining the ground until it finds a moderately deep depression, if possible near a high tuft of grass.

Using this depression as the foundation of the nest, it builds a roof over it with leaves, grass, and similar materials, not high enough to overtop the neighbouring herbage, and being very similar to it in external appear-

ance. Grass of a suitable length cannot always be obtained close to the nest, and the Bettong is therefore obliged to convey it from a distance. This task it performs in a manner so curious, that were it not related by so accurate and trustworthy an observer as Mr. Gould, it could hardly be credited. After the animal has procured a moderately large bunch of grass, it rolls its tail round it so as to form it into a sheaf, and then jumps away to its nest, carrying the bunch of grass in its tail. In Mr. Gould's work on the Macropidæ of Australia, there is an illustration which represents the Bettong leaping over the ground with its grass sheaf behind it. After the nest has been completed, the mother Bettong is always careful to close the entrance whenever she leaves her home, pulling a loose tuft of grass over the aperture.

To an ordinary European eye, the homes of the Bettong are quite undistinguishable from the surrounding grass. The natives, however, seldom pass a nest without seeing it, and destroying the inmate. Being a nocturnal animal, the Bettong is sure to be at home and asleep during the daytime, so that when a native passes a nest he always dashes his tomahawk into its midst, thus killing or stunning the sleeping inmates.

The second Building Mammal on our list is also a native of Australia, and is known by the name of RABBIT-EARED BANDICOOT. Of the two generic names the latter is certainly preferable, as it alludes to the remarkable structure of the limbs. The fore feet are small and delicate, and only two toes are developed. Instead of being furnished with long claws at their extremity, the feet are terminated by two short and pointed claws of equal length, and looking exactly like the hoofs of a pig. It is in allusion to this peculiarity that the generic name "Chœropus," or swine-footed, has been given to the animal.

It is a rather odd-looking little creature, about as large as an ordinary rabbit, and having ears so long and large that the resemblance to the rabbit is really striking. Owing to the great length of the hind legs, the gait of the animal is rather peculiar, being a kind of mixture between walking and hopping, and when the creature is alarmed, it jumps away with wonderful speed. Specimens of this Bandicoot have lived in England.

The nest which it makes is not unlike that of the Bettong, which has been already described. The animal inhabits the same kind of locality—namely, grass-covered hills and “scrubs,” and builds its nest of grass and leaves, sheltering it if possible beneath a grass tuft or some thick bush. The Rabbit-eared Bandicoot inhabits New South Wales, and the nests are chiefly to be found near the banks of the Murray River. They are, however, so cleverly hidden, and the materials of which they are built are so similar to surrounding objects, that an inexperienced person might almost walk over them without discovering their presence.

We now come to our last example of the Building Mammalia—namely, the MUSQUASH, or ONDATRA of North America, sometimes called the Musk Rat.

This animal might have been placed among the burrowers, for it is quite as good an excavator as many which have been described under that title, but as it builds as well as burrows, it has been described among the builders.

Essentially a bank-haunting animal, it is never to be seen at any great distance from water, and like the beaver, to which it is closely allied, it is usually to be found either in the river itself or on its edge, where its brown wet fur harmonises so well with the brown wet mud, that the creature can scarcely be distinguished from the surrounding soil. It is seen to the best advantage in the water, where it swims and dives with consummate

ease, aided greatly by the webs which connect the hinder toes.

The Musquash drives a large series of tunnels into the bank, excavated in various directions, and having several entrances, all of which open under the surface of the water. The tunnels are of considerable length, some being as much as fifty or sixty feet in length, and they all slope slightly upwards, uniting in a single chamber in which is the couch of the inhabitants. If the animal happens to live upon a marshy and uniformly wet soil, it becomes a builder, and erects houses so large that they look like small haystacks. Sometimes these houses are from three to four feet in height.

The natives take advantage of the habits of the animal, and kill it while it lies on its couch, much after the same manner as is used by the natives of Australia when they pass the house of the Bettong. Taking in his hand a large four-barbed spear, shaped something like the well-known "grains" with which sailors kill dolphins and porpoises, the native steals up to the house, and driving his formidable weapon through the walls, is sure to transfix the inhabitants. Holding the spear firmly with one hand, with the other he takes his tomahawk from his belt, dashes the house to pieces, and secures the unfortunate animals.

As the fur of the Musquash is valuable, and the flesh is considered as good as that of the duck, it is greatly persecuted by hunters, who generally employ one of four methods, two of which require a knowledge of the home. One plan has already been described, and another consists in finding out the different entrances, blocking them up, and then intercepting the animals as they try to escape. Sometimes the gun is used, but not very frequently, as the Musquash is so wary, that it dives at the least alarm, darts into one of its holes, and will not show itself again until assured of safety. The trap, however, is the ordinary means of destruction. This is made of iron, and is set in

such a manner that as soon as the animal is caught its struggles cause the trap to fall into the water, dragging after it the Musquash, which is soon drowned.

In its subterranean home the Musquash lays up large stores of provisions, and in the habitation have been found turnips, parsnips, carrots, and even maize. All the roots had been dug out of the soil, and the maize had been bitten off close to the ground. The Musquash is not a large animal, the length of its head and body being only fourteen inches.

I have in my collection a curious bag or pouch made from the skin of the Musquash by a very simple process. The animal has been laid on its back, and the skin divided transversely across the lower part of the abdomen. The body has then been gradually turned out of the skin, all the limbs removed except the paws, and the skull also taken away. The inside of the skin is then dried, and prepared in some ingenious manner, so that it serves as a convenient pouch, the slit across the abdomen forming the entrance, the tail acting as a handle for suspension, and the feet dangling as ornaments. For this curious specimen I am indebted to Lieutenant Pusey, R N.

## CHAPTER VII.

*BUILDING BIRDS.*

The OVEN BIRD and its place in ornithology—Its general habits—Nest of the Oven Bird—Curious materials and historical parallel—The specimens in the British Museum—The internal architecture of the nest—Division into chambers—The PIED GRALLINA—The specimens at the Zoological Gardens—Materials and form of the nest—Boldness of the bird—The SONG THRUSH and its nest—The BLACKBIRD and its clay-lined nests—Supposed reasons for the lining—The FAIRY MARTIN—Locality, shape, and materials of the nest—Social habits of the bird—How the nest is built—The RUFOUS-NECKED SWALLOW—Locality and abundance of its nests—Curious habit of the bird—Audubon's account—The RUFOUS-BELLIED SWALLOW—Supplementary nest—How the bird builds—Popular superstition and its uses—The HOUSE MARTIN—Material of its nest—Favourite localities—Ingenuity of the Martin—Adaptation to circumstances—Parasitic intruders, their number, dimensions, and tenacity of life—The SWALLOW—Distinction between its nest and that of the Martin—Why called the Chimney Swallow—TALLEGALLA, or BRUSH TURKEY—The illustration explained—Various names of the bird—Its singular and enormous nest—How the eggs are laid and hatched—Egress of the young—Remarkable instinct—AUSTRALIAN JUNGLE FOWL—Shape, size, and position of its nests—How the eggs are discovered—LEIPOA or NATIVE PHEASANT—Its mound-nest, and general habits.

AMONG the building birds there is one species which is pre-eminently chief. Not only is there no equal, but there is no second. This is the OVEN BIRD, which derives its popular name from the shape and material of its nest.

The Oven Bird belongs to the family of the Certhidae, and is therefore allied to the well-known Creeper of our own country. It is about as large as a lark, and is a bold-looking bird, rather slenderly built, and standing



OVEN BIRD

very upright. Its colour is warm brown. It is very active, running and walking very fast, and is much on the wing, though its flights are not of long duration, consisting chiefly of short flittings from bush to bush

in search of insects. It generally haunts the banks of South American rivers, and is a fearless little bird, not being alarmed even at the presence of man. The male has a hard shrill note, and the female has a cry of somewhat similar sound, but much weaker.

The chief interest of this bird centres in its nest, which is a truly remarkable example of bird architecture. The material of which it is made is principally mud or clay obtained from the river banks, but it is strengthened and stiffened by the admixture of grass, vegetable fibres, and stems of various plants. The heat of the sun is sufficient to harden it, and when it has been thoroughly dried, it is so strong that it seems more like the hand-work of some novice at pottery than a veritable nest constructed by a bird, the fierce heat of the tropical sun baking the clay nearly as hard as brick.

The ordinary shape of the nest may be seen by reference to the illustration, which is drawn from a remarkably fine specimen in the British Museum. It is domed, rounded, and has the entrance in the side. Its walls are fully an inch in thickness, and it seems strong enough to bear rolling about on the ground. This specimen was placed on a branch, but the bird is not very particular as to the locality of its nest, sometimes building it on a branch of a tree, sometimes on a beam in an outhouse, and now and then on the top of palings; generally, however, it is built in the bushes, but without any attempt at concealment. Owing to its dimensions and shape, the nest is extremely conspicuous, and the utter indifference of the bird on this subject is not the least curious part of its history.

Strong as is the nest, it is still further strengthened by a peculiarity in the architecture, which is not visible from the exterior. If one of the nests be carefully divided, the observer will see that the interior is even more singular than the outside. Crossing the nest from side to side is a wall or partition, made of the same

materials as the outer shell, and reaching nearly to the top of the dome, thus dividing the nest into two chambers, and having also the effect of strengthening the whole structure. The inner chamber is devoted to the work of incubation, and within it is a soft bed of feathers on which the eggs are placed. The female sits upon them in this dark chamber, and the outer room is probably used by her mate. The reader will remember that several instances of such supplementary nests have already been mentioned. The eggs are generally four in number.

Both sexes work at the construction of the nest, and seem to find the labour rather long and severe, as they are continually employed in fetching clay, grass, and other materials, or in working them together with their bills. While thus employed they are very jealous of the presence of other birds, and drive them away fiercely, screaming shrilly as they attack the intruder.

Australia produces the two remarkable birds whose nests are given in the accompanying illustration.

The first of these feathered builders is the PIED GRALLINA, a bird which has become familiar to the public since its introduction to the Zoological Gardens. A pair of these birds have lived for some time in the Aquarium House, and have always attracted much attention as they fly to and fro in the large enclosure which is dedicated to them, to the dabchicks, kingfishers, wagtails, and other water-loving birds. Owing to the bold contrasts of black and white in their colouring they are very conspicuous, and their restless movements always attract the eye.

Although in its shape the nest of the Pied Grallina does not resemble that of the Oven Bird, the materials with which it is constructed are almost identical, consisting of mud and clay, in which are interwoven certain sticks, grasses, feathers, and stems of plants, which serve

to bind the clay together, just as cows' hair binds together the plaster on our walls. When looking at these



FAIRY MARTIN

PIED GRALLINA

nests, the observer is irresistibly reminded of the old Babylonish bricks, in which the grass and straw still

remain, and serve to strengthen the ill-burned clay, which in many cases was only dried in the sun. Possibly, if the bird were deprived of such materials, and only furnished with mud and clay, it would be as much at a loss as were the captive Israelites when they were compelled to make bricks without being supplied with straw.

Like the *Oven* bird, the *Pied Grallina* makes no attempt to conceal its nest, but places it quite conspicuously on a branch, as is shown in the illustration. It is almost invariably built on a bough which overhangs the water, and in spite of its weight and size, is fixed so firmly to the branch that there is no fear lest it should overbalance itself. The walls of the nest are very thick and solid, and the whole edifice looks very like an exceedingly rude and ill-baked earthenware vessel, just such an one, indeed, as Robinson Crusoe manufactured on his island. The bird is widely spread over Australia, so that its nest may be found in many parts of the country.

I may here mention that two of our best known song-birds form a basin-like nest of somewhat similar materials. Every one who has taken the nest of a *SONG THRUSH* will remember that its interior is lined with a cup of a substance that resembles clay, but which is in fact composed chiefly of cowdung and decayed wood. This cup is exceedingly thin, but it is very hard and tough, and is so compact in its structure that it will hold water for some time. Like the mud wall of the *Pied Grallina*, it is strengthened by sticks and grass, with this difference, that whereas the latter bird incorporates the sticks and straws with the mud, the Thrush works the cup upon the sticks and straws.

The *BLACKBIRD*, too, has a similar habit, only it employs veritable mud for the purpose, and spreads it in a much thicker layer than the Thrush. The eggs,

however, are not placed on the dried mud, but on a layer of very fine grass. The object of this curious lining seems to be still undiscovered. Both the birds build in similar localities, and both make their nests close to the ground. It is possible that the stout walls may prevent the weasel or stoat from tearing the nest away from below, and so catching the young birds, but this is mere conjecture. Even the muddy lining does not repel all such attacks, for I once knew a dog that was in the habit of searching for nests of both these birds, and of eating the eggs and the young. He always obtained his prey by getting under the nest, biting out the bottom, and receiving the contents in his mouth.

The curious flask-shaped nests which are seen in the illustration are built wholly of clay and mud, and are made by a beautiful little Australian bird, named the FAIRY MARTIN, closely allied, as its generic name signifies, to the swallows and martins of our own country. The bird is spread over the whole of Southern Australia, where it arrives in August, and whither it departs in September.

These remarkable nests are generally to be found upon rocks, and are always close to rivers, but have never been seen within many miles of the sea. Sometimes, however, the bird chooses another locality, and, instead of fixing its nests to the side of a rock, attaches them to the interior of one of the huge hollow trees which are so common in Australia. Now and then it behaves like the martin of England, and builds its nest under the protection of human habitations.

The shape of the nests always resembles that of a flask or retort, and their size is extremely variable, the length of the spouts, or necks, being from seven to ten inches, and the diameter of the bulb varying from four to seven inches. Mr. Gould mentions, in his work

on the Birds of Australia, that each nest is the joint work of several birds, six or seven being sometimes employed upon one nest, one sitting in the interior, as chief architect, arranging and smoothing the material, while the others go off in search of mud and clay, which they knead well in their mouths before applying it to the nest.

As is generally the case with clay which is thus kneaded, it becomes very hard when baked in the sun, but, at the same time, is rather slow in drying. When the weather is dry, the bird can only work in the mornings and evenings, because the heat of the sun-beams soon renders the clay too stiff to be worked by the delicate beaks of the birds, and, therefore, in the middle of the day, the Fairy Martins cease from their architectural labours, and do nothing but chase flies. During wet weather, however, when no flies are abroad, and the air is full of moisture, the birds work continually at their nests, and soon complete their labours.

The exterior of the nest is quite as rough as that of the common English martin; but in the interior it is beautifully smooth. The birds do not seem to have any particular care about the point of the compass towards which the entrance looks, but arrange it indifferently in any direction.

The Fairy Martin is a prolific little bird, laying four or five eggs, and rearing two broods in a year.

There is an American Swallow which builds a nest very similar in form to that of the Fairy Martin. This is the RUFOUS-NECKED SWALLOW, whose nests are made of mud, and flask-shaped, but have a wider and shorter neck than is the case with the nest of the Fairy Martin. On account of its gregarious propensities, it is sometimes called the REPUBLICAN SWALLOW. Wherever a favourable spot is found, such as a perpendicular rock with an overhanging shelf, the nests are built in profusion,

being placed so close to each other that the rock is almost covered with them.

The birds are also gregarious on the wing as well as in nesting, as will be seen by Audubon's remarks upon their habits:—"About sunset they begin to flock together, calling to each other for that purpose; and in a short time presented the appearance of clouds moving towards the lakes on the mouth of the Mississippi, as the weather and wind suited. Their aerial evolutions before they alight are truly beautiful. They appear at first as if reconnoitering the place, when, suddenly throwing themselves into a vortex of apparent confusion, they descend spirally with astonishing quickness, and very much resemble a *trombe* or water-spout. When within a few feet of the *ciriers*, they disperse in all directions, and settle in a few moments. Their twitterings and the motion of their wings are, however, heard during the whole night.

"As soon as the day begins to dawn, they rise, flying low over the lakes, almost touching the water for some time, and then rising, gradually move off in search of food, separating in different directions. The hunters who resort to these places destroy great numbers of them, by knocking them down with light paddles, used in propelling their canoes." The *cirier* which is here mentioned is the French popular name for the *Myrica cerifera*, a shrub belonging to the same genus as the well-known British shrub called Sweet Gale, or Dutch Myrtle.

Another American bird, the RUFOUS-BELLIED SWALLOW, is notable for the nest which it makes. This species follows the example of the Oven Bird in its selection of materials, strengthening the mud walls of its nest with fine hay. The nest is furthermore remarkable for having a supplementary perch, or small nest attached to the larger one, serving as a seat for the male, while his

mate is engaged in the business of incubation. On such occasions he is in the habit of pouring forth a lively, though not varied song, being, in fact, a sustained twitter. The shell of the nest is about an inch in thickness, and the mixed mud and hay are arranged in regular layers. Owing to the thickness, and the complicated structure of the nest, a full week is required for its completion. The form of the nest is nearly that of an inverted cone, being flattened on the side which is set against the wall or rock. The bird is of gregarious habits, and twenty or thirty nests are often seen so close together that a finger can scarcely be placed between them.

Fortunately for itself, this bird is protected by popular superstition, which attributes all kinds of ill-luck to the person who kills one of them. Wilson remarks that, in consequence of long immunity, they feel so secure among human habitations, that although the woods may be destitute of them, every farm-house is sure to attract them. There is scarcely a barn in which they will not build; and right glad is the farmer when they take possession of a house, for, according to popular belief, such a building will never be injured by lightning. He further mentions, that a farmer said, that if he were to permit his swallows to be shot, all his cows would give bloody milk; to which remark Wilson merely nodded assent, being unwilling to disturb any feeling, however superstitious, which had for its object the protection of useful birds.

We have several builders among our British birds, the best known of which is the common HOUSE MARTIN, whose nests are so plentiful upon the walls of our houses.

The material of which the nests are built is a kind of mud, which becomes tolerably hard when dry, and is strong enough to exist for a series of years, and to

serve for the bringing up of many successive broods. The bird is exceedingly capricious as to the spot which it selects for its residence, some houses being crowded with the mud-built nests, while others are free from them. The points of the compass are always noted by the Martin, for there are some points which it clearly detests, while it is equally fond of others. A wall with a north-eastern aspect is a favourite locality, while a southern wall is seldom chosen, probably because the heat of the meridian sun might dry the mud too quickly, or might cause inconvenience to the young birds.

My own house, however, forms an exception to this general rule, for the Martins have chosen to build on the south wall only, probably because the eaves project so far that after nine A.M. the nests are in shadow. Moreover, there is a narrow ledge, barely an inch in width, which runs under the eaves, and forms a support for the nests. While the Martins were engaged in bringing up their young, I ascended to the nests, and inspected them carefully, much to the indignation of the parent birds, who flew about wildly, darting occasionally out of their nests, and then stopping short and dashing away over the house. The opening of the nest being close against the eaves, the interior could not be inspected; but the touch of the finger showed that the walls were tolerably smooth, forming a great contrast with the rough exterior. The young birds were quite as much alarmed as their parents, and shrank to the very bottom of the nest, where they were quite invisible.

As to the nests themselves, they are exceedingly irregular on the outside, and look as if they had been made of that preternaturally ugly substance called "rough-cast," with which the walls of houses are sometimes disfigured. The material of which the Martin makes its nest is said to be the earth that is ejecte

by worms; but that this substance does not form the whole of the material is evident from the fact that stones, grass, and feathers are mixed with the mud, together with small twigs and a few fine roots of an inch or two in length.

The Martin is a rather ingenious bird, and is always ready to take advantage of any circumstance which may aid it in building its nest. The inch-wide ledge, for example, which I have just mentioned, has been quite appropriated by Martins, and there is scarcely a part of it which does not bear marks of their labours. At least a dozen nests have been begun and abandoned after a few beakfuls of mud have been put together, probably because the position is so exceedingly advantageous that the birds can scarcely begin in one place without regretting that they have not chosen a neighbouring spot.

There is an interesting account in the "Zoologist," of the unexpected skill displayed by these birds:—"Under the eaves of a house, not so high as to be beyond the reach of any urchin who could procure a rod or fling a stone, a Martin had built its nest, which had more than once been destroyed. There is no doubt that, under ordinary circumstances, these birds would have gone on building their habitation in the same place and manner, if left to themselves and their own resources, although even in such cases some important variation in the structure has been known to have occurred. But, in the present instance, the inhabitants of the cottage were not satisfied to see the labours of their favourite perpetually rendered void, and they set their wits to work, in what manner to secure them from harm.

"The method adopted was, to place a small round basket under the eaves, at the place where the nest had been, as a protection from injury below; but it was attended with the inconvenience that the handle pre-

vented it from being pressed into contact with the stone, while the breadth of the basket was so great as to cause the wet dripping from the eaves to fall within the cavity. It was to obviate this last annoyance that a flat piece of board was laid as a cover to the basket, with the precaution of leaving an opening, not in front, but at the side, for the birds to enter, if they should choose to adopt this new contrivance for their advantage; and they did justice to the kind intentions of their friends by adopting it, and that, too, in a way of their own contrivance. They began by placing a rim of their usual mortar round the basket, at the border where the covering board rested on it; but in thus rendering it safe and close on every side, they observed the precaution of leaving a small hole at the side, by which to enter. In this convenient piece of wicker-work they formed a cradle, in which they were able successfully to rear their brood.

"But this was not all. Another pair of birds had seen the good fortune of their fellows, and they resolved to be sharers in the advantage they were enjoying. The space above the board, and within the arched handle of the basket, was only inferior to the basket itself as a situation for a nest, and there, accordingly, they proceeded to place it. It was formed of clay, in the usual manner, and here, immediately above their neighbours, they successfully hatched their young . . . The laying hold of a novel, but obvious convenience to secure an important object, is not the least of the operations of the reasoning powers."

The writer of this notice is quite correct in attributing the performances of these birds to reason, and not to instinct. Instinct would have taught them to make their nests under ordinary conditions, and to raise their clay-built houses against a wall. But the mental process which led them to accommodate themselves to such a change of circumstances as the substitution of a basket

for a wall does, undoubtedly, belong to the province of reason, rather than of instinct.

To examine minutely the economy of a Martin's nest is a pleasant task enough, but has its drawbacks, which are very numerous, and may be summed up in one word—vermin.

All birds are liable to the attacks of parasitic insects, but the Martins contrive to harbour such quantities of them that the spectator cannot but wonder how they contrive to live through the constant attacks. The nest itself swarms with them, and so numerous are their hosts that I have found an isolated lump of clay filled with these repulsive insects, though at the distance of eighteen inches from the nest. They are not visible at first, and but for their cast skins would probably attract no notice. But when one of these innocent-looking pieces of mud is removed, and put under a glass in which a few drops of spirits of turpentine have been placed, the vermin come trooping out of every crevice, many in numbers, large in dimensions, and obese in outline.

In one lump of clay about as large as a walnut, I have seen so many parasites that they seemed capable of devouring all the little birds; and when it is remembered that every portion of the nest is equally tenanted, how the inmates can survive for a single night is indeed matter of surprise. Their size is absolutely portentous, for when compared with the birds on which they feed, they are as large as full-grown frogs compared with men. I mention this circumstance in order that my readers may be chary of bringing a Martin's nest into a room, for to introduce such pests into the house is far more easy than to extirpate them. Most insects are killed at once by inhaling the vapour of turpentine, but I have kept a number of them shut up in a tin box in which some spirits of turpentine had been poured, and after six and thirty hours found them still alive.

They certainly dislike the vapour, and it has the effect of stupefying them. But, as soon as they are removed from its influence, the fresh air seems to restore them, and they begin to crawl about again.

The common SWALLOW also makes a clay-built nest, similar in many respects to that of the martin, but differing in its shape. The nest of the martin is always covered, and entered by an aperture on one side. Mostly it is built immediately under a projecting ledge, which answers the purpose of a roof, but if no such accommodation can be obtained, it covers in the nest with a dome-like roof. The nest of the Swallow, on the contrary, is open at the top, probably because the long forked tail would be crushed if pressed into so small a compass, while the shorter and simpler tail of the martin does not require so much space.

Wherever it can find an old chimney, the Swallow will always build its nest therein, a habit which has gained for the bird the popular title of Chimney Swallow. It will, however, build in many other situations, such as precipitous rocks and quarries, barns, outhouses, and steeples. There are usually five eggs, and the nest is lined with a soft bed of feathers, like that of the martin.

I must now refer the reader to the large illustration, wherein is depicted a group of natives engaged in digging eggs out of an earth-heap. This engraving represents a scene of very common occurrence in Australia, and serves to illustrate the habits of the natives as well as of the bird which will presently be described.

In the foreground is a group of natives resting themselves after a successful hunt, the evidences of which are scattered around them. The weapons by which they were killed are thrown carelessly on the ground,



NEST OF TALLEGALLA.

and comprise the waddy or club, the boomerang, the spear, and the wummerah or throwing stick, by which it is hurled with terrific force. The large wooden shield indicates also that the natives in question consider themselves in danger of hostile tribes. In the centre of the illustration is seen an old man crouched upon his knees, busily engaged in digging from a large mound some eggs which are arranged nearly in a circle, and are set perpendicularly with their larger end upwards, as if they had been placed there by the Opposition party in Lilliput.

This mound is the work of an Australian bird popularly called the BRUSH TURKEY or TALLEGALLA, one of a small series of birds which scrape together great heaps of vegetable substances, and lay their eggs in them so as to be hatched by the heat given out during the process of fermentation. A very brief account of these birds will be given, but we will at present confine ourselves to the Tallegalla.

This bird belongs to the order Gallinæ and the family Megapodidæ, or large-footed birds, the name being given to them on account of the very great comparative size of the feet. It is a native of New South Wales, and is generally found in the densest bushes, through which it can make its way with such rapidity that it can scarcely be captured. As the bird is called by many names, I will mention one or two of them, so that the reader may be better able to identify it while reading the accounts of observant but unscientific travellers. The natives sometimes call it Tallegalla, and sometimes Weelah; and it is occasionally named the New Holland Vulture, because the bare head and neck give it a somewhat vulturine aspect.

We will now proceed to the nest itself.

This curious edifice is often of very great size, several cartloads of materials being used, and its dimensions enlarged from year to year. In order to show the

general appearance of the nest, an example is shown with the bird running over it. The mound is conical in shape, and, as may be imagined from its enormous size, is the result of joint labour, several hens uniting in its formation. The method by which it is made is very curious, and Mr. Gould's account of the bird has been fully corroborated by the habits of the birds in the Zoological Gardens.



Tracing a circle of considerable radius, the birds begin to travel round it, continually grasping with their large feet the leaves, and grasses, and dead twigs which are lying about, and flinging them inwards towards the centre. Each time that they complete their rounds they narrow their circle, so that in a short time they clear away a large circular belt, having in its centre a low, irregular heap. By repeating the same process, however, they decrease the diameter of the mound as they increase its height, and at last a large and rudely conical mound is formed.

The next process is to scrape away the middle of the heap until a cavity of nearly two feet is formed, in which the eggs are carefully placed, being set in the peculiar manner which has also been mentioned. They are then covered up, and are hatched by the joint effects of fermentation and hot sunbeams. By adopting this process the bird does not escape any of the cares of maternity, for the male is very watchful over the eggs, being gifted with a wonderful instinct which tells him of the temperature which is proper for them. Sometimes he covers them with a thick layer of leaves, and some-

times he lays them nearly bare, these operations being repeated several times in a single day.

At last the eggs are hatched, but when the young bird escapes from the shell, it does not emerge from the mound, remaining therein for at least twelve hours. Even after it has enjoyed the open air it retires to the mound towards evening, and is covered up like the eggs, only not to so great a depth. It is a remarkable fact that in all cases a nearly cylindrical hole is preserved in the middle of the mound, being evidently intended as a chimney by which the heat may be moderated, and through which gases produced by fermentation may escape. The reader will probably call to mind that in a well-made haystack a central aperture is preserved for exactly the same purpose, the modern farmer having therefore been anticipated by a bird.

A very great number of eggs are placed in the nest, a bushel of eggs being sometimes taken out of a single mound. These eggs are peculiarly well flavoured, and are equally sought by natives and colonists. The Talle-galla has a habit of scratching large holes in the ground while dusting itself after the manner of gallinaceous birds, and these holes often serve to direct the experienced hunter towards the nest itself.

Another species of mound-making bird is tolerably common about Port Essington. This is the AUSTRALIAN JUNGLE FOWL, which makes earth-mounds of prodigious size, one of them which was measured being no less than fifteen feet in perpendicular height, and twenty feet in diameter. If the reader will measure off twenty feet along the floor of a room, and fifteen feet upon the walls, he will form a conception of the enormous size of these tumuli. These heaps are always placed under shelter, and are sometimes so enveloped in foliage that, in spite of their great size, they can scarcely be discovered. The materials of which they are composed

are rather variable, according to the locality, but the general mass consists of leaves, grass, and other vegetable matter.

Vast numbers of eggs are laid in these nests, and are placed at a considerable depth, some of them being as much as six or seven feet from the top of the heap. They are deposited in a curious manner, the bird scratching its way into the heap, laying an egg, and then filling up the hole as she makes her way out again. The natives always use their hands in digging out these eggs, because their fingers can follow the track of the bird, the softer and looser material acting as a guide. A twig is generally used as a probe by which the presence of a hole is detected, but the hands are the only tools which are used in following up the tortuous track, which sometimes proceeds in a straight line, and then turns suddenly at an angle, the bird having come on a stone or some such obstacle which prevents her from continuing in the same line.

It is a remarkable fact that these mounds are always found near the sea, and in one instance a heap was seen on the very shore, only just above highwater mark.

The curious bird called by the natives LEIPOA, and by colonists the NATIVE PHEASANT, is another of the mound-makers. In order to avoid confusing the mind of the reader, I may here mention that there are three Australian birds which are popularly called pheasants, the one being the Leipoa, and the others the two species of lyre-bird. The Leipoa certainly has a very pheasant-like appearance, both in the general outline of the head and body, together with the pencilled plumage, the long tail being only wanted in order to complete the resemblance. It is usually found towards the north-west portions of Australia, preferring sandy plains to any other localities.

The mound which is made by the Leipoa is comparatively small, being seldom more than eight or nine feet in diameter, and a yard or so in height. It is made up of mixed sand, soil, leaves and grass, and is sometimes so hard at its lowest portions, that the hands become useless in digging out the eggs, and strong tools are required. In each nest there are usually about a dozen eggs, which are deposited singly in the mound. One nest, however, will afford a large supply of eggs, just as is the case with our domestic hens, for if her nest be repeatedly robbed, the bird continues to lay for a very long time. The eggs are whitish, slightly speckled with dull red. It is a curious fact that a number of ants are always to be found about the nest of the Leipoa, and their presence, together with the hard, strong substance of the lower part of the nest, would lead many persons to suppose that the mound was nothing but a large ant-hill.

## CHAPTER VIII

*BUILDING BIRDS (Continued)*

Nesting of the Hornbills—Dr Livingstone's account of the KORWK, or RED-BREASTED HORNBILL—The LONG-TAILED TITMOUSE—Its general habits—Its use to the gardener—Number of the young—Form and materials of the nest—Localities chosen by the bird—How to prepare the fragile eggs—The MAGPIE—Its domed and fortified nest—The COMMON WREN and its nest—Pseudo nests and their probable origin—The HOUSE WREN of America—Its habits and mode of nesting—Wilson's account of the bird—Its usefulness and quarrelsome nature—The LYRE BIRD—Origin of its name—Its domed nest—The ALBERT'S LYRE BIRD and its habits—The BOWER BIRD—Why so called—Civilisation and social amusement—The remarkable bower—Its materials and mode of construction—Use to which it is put—The Bower Birds in the Zoological Gardens, and their habits—Love of ornament—Meaning of the scientific name—The SPOTTED BOWER BIRD of New South Wales—Its bower—Description of the birds and their place in the present system

THE reader may remember that in the account of the toucan and its semi-burrowing mode of nesting, it was mentioned that the bird was sometimes in the habit of closing the aperture of its nest with mud. It is a very remarkable fact that both groups of large-billed birds should possess the same habit, and that the HORN-BILL of Africa should close its nest with mud like the toucan of tropical America. These groups of birds are somewhat similar in external appearance, the huge

beak giving them a kind of family likeness. They are, however, widely distinct in zoological systems, the toucans belonging to the scansorial, or climbing birds, and the hornbills ranking with the touracos, plantain-eaters, and colies.

Like the toucan, the Hornbill makes its nest in the hole of some decaying tree, and one of the species, at all events, seems invariably to reduce the size of the entrance by plastering it up with mud, and leaving only a very little aperture. The following interesting account of the Hornbill and its nest is quoted from Dr. Livingstone's well-known work :—

" We passed through large tracks of Mopane country, and my men caught a great many of the birds called KORWÉ in their hiding-places, which were in holes in the mopane-tree. On the 19th (February) we passed the nest of a Korwé, just ready for the female to enter, the orifice was plastered on both sides, but a space was left of a heart shape, and exactly the size of the bird's body. The hole in the tree was in every case found to be prolonged some distance upwards above the opening, and thither the Korwé always fled to escape being caught. In another nest we found that one white egg, much like that of the pigeon, was laid, and the bird dropped another when captured. She had four besides in the ovarium.

" The first time that I saw this bird was at Kolobeng, where I had gone to the forest for some timber. Standing by a tree, a native looked behind me, and exclaimed, ' There is the nest of a Korwé' I saw a slit, only about half an inch wide and three or four inches long, in a slight hollow of the tree. Thinking the word 'Korwé' denoted some small animal, I waited with interest to see what he would extract; he broke the clay which surrounded the slit, put his arm into the hole, and brought out a *Tockus*, or Red-breasted Hornbill, which he killed.

"He informed me that when the female enters her nest, she submits to a real confinement. The male plasters up the entrance, leaving only a narrow slit by which to feed his mate, and which exactly suits the form of his beak. The female makes a nest of her own feathers, lays her eggs, hatches them, and remains with the young till they are fully fledged. During all this time, which is stated to be two or three months, the male continues to feed her and the young family. The prisoner generally becomes fat, and is esteemed a very dainty morsel by the natives, while the poor slave of a husband gets so lean that, on the sudden lowering of the temperature, which sometimes happens after a fall of rain, he is benumbed, falls down, and dies. I never had an opportunity of ascertaining the exact length of the confinement, but on passing the same tree at Kolobeng about eight days afterwards, the hole was plastered up again, as if in the short time that had elapsed the disconsolate husband had secured another wife. We did not disturb her, and my duties prevented me from returning to the spot.

"This (February) is the month in which the female enters the nest. We had seen one of these, as before mentioned, with the plastering not quite finished; we saw many completed, and we received here the very same account that we did at Kolobeng, that the bird comes forth when the young are fully fledged, at the period when the corn is ripe; indeed, her appearance abroad with her young, is one of the signs they have for knowing when it ought to be so. As that is about the end of April, the time is between two and three months. She is said sometimes to hatch two eggs, and when the young of these are full-fledged, other two are just out of the egg-shells: she then leaves the nest with the two elder, the orifice is again plastered up, and both male and female attend to the wants of the young which are left."

In this curious history of bird architecture, two points are peculiarly interesting, one being the reservation of a higher point whereto the bird may fly in case of invasion, and the other the fact that two broods of young can be in the nest at one time.

Passing from the birds which build with mud, we now come to those which use vegetable substances in their habitations. As examples of such architecture, we shall select the nests of those birds which are able to construct domed habitations, as well as the remarkable structures which are built by the Bower-birds of Australia.

The LONG-TAILED TITMOUSE constructs a nest which is quite as wonderful in its way as the pensile home of the harvest mouse.

This pretty little bird is very plentiful in England, and owing to its habit of associating in little flocks of ten or twelve in number, and the exceeding restlessness of its character, is very familiar to all observers of nature. These flocks generally consist of the parent and their offspring, for the little creature is exceedingly prolific, laying a vast quantity of tiny eggs in its warm nest, and rearing most of the young to maturity. This is a bird which ought to be cherished by all possessors of fields or gardens, for there is scarcely a more determined enemy to the many noxious insects which destroy the fruits, vegetables, and flowers. Fortunately for ourselves the Long-tailed Titmouse is very fond of the sawflies, that work such mischief among our fruit trees, and often lay waste whole acres of gooseberries, and no exaggeration to say that to a possessor of an orchard or a fruit garden of any kind, every Long-tailed Titmouse is well worth its little weight in gold.

Were it only for the beauty and elegance of its fe-

no one who had an eye for living art could kill the pretty little bird, and reduce the bright, active, happy creature to a mere pinch of ruffled feathers. Were it only for the wonderful structure of its nest, it would be worthy



THE LONG-TAILED TITMOUSE

of preservation. But when we come to consider the uses+inable and inappreciated services which this tiny hummers to mankind, we should not only be devoid webs of stitude, but likewise of all common sense—which caterpi"

however comes to much the same point—were we willingly to destroy our feathered benefactor.

Although almost every one who lives in the country or who possesses a tolerably large garden in a town is perfectly familiar with this bird, comparatively few are in a position to narrate from personal observation the benefits which it confers upon us. The reason is simple; they do not rise early enough. A Long-tailed Titmouse in early morning, and the identical bird at noon, scarcely seem to be the same creature, so different are its ways. It is a specially early bird, earlier than the sparrow, which is apt to be rather a sluggard as regards leaving its nest, though it sets up its garrulous chirp soon after daybreak. At that hour of the morning the Long-tailed Titmouse seems to cast off fear and diffidence, and allows itself to be watched without displaying much alarm. Indeed, with the aid of a good opera-glass, it may be observed almost as well as if it were in a cage.

As the sun ascends above the horizon, and men and boys begin to go about to their daily work, the Titmouse loses its easy confidence, and will not suffer itself to be approached so calmly as in the early morning. Generally, somewhere about five or six A.M., it leaves the garden and flies afield, and must then be sought far from human habitation. If, however, the garden should happen to be surrounded by walls, and the owner should happen to understand humanity as well as self-interest, the little bird will know that it will not be disturbed, and will remain in its sanctuary throughout the greater part of the day.

The quick, lively movements of the little creature are quite indescribable, so incessant and so varied are its changes of attitude. As it runs about the branches, it seems almost independent of gravity, and is equally at its ease whether its head, back, or breast be "up." It ever and anon utters an odd chirping note, seems to issue from the bird as if it proceeded

some internal machinery, and were independent of the will of the creature which utters it. The observer should be careful to notice its quick, frequent pecks, and may be sure that every such movement denotes the slaughter of some insect, whether in the stage of egg, larva, pupa, or imago. The little beak is by no means so feeble as it seems, and is able to pick up an insect so small as would escape the observation of human eyes, or to pounce upon and destroy one which many a human being would not care to handle.

All the little flock, which are seen flitting about the trees, darting from branch to branch and tree to tree as if they were little arrows projected from bows, have at one time been inmates of the same nest, the beautiful domed structure which is shown in the illustration. How they are accommodated in so small a space seems quite a mystery, for not only is the hollow of the nest of no great size, but the interior is so filled with feathers and down that the space is still further limited.

The nest of the Long-tailed Titmouse is rather variable in shape, but its usual form is shown in the illustration. Generally, it is rather oval, and has an aperture at one side and near the top, through which the birds can pass. I believe that all domed nests, whether of bird or beast, are constructed by at least two architects, one of which remains within, while the other works from without. This is certainly the case with many creatures, and is probably so with all. The materials of which the nest is made are mosses of various kinds, wool, hair, and similar substances, woven by them with great firmness. It is remarkable that in the construction of this nest, which requires peculiar solidity, the Long-tailed Titmouse uses materials like those which are employed by the humming birds, and binds its nest together with the webs of spiders, and the silken hammocks of various mere caterpillars. The exterior of the nest is covered with

lichens, so that the whole edifice looks very much like a natural excrescence upon the tree or bush in which it is placed, as is the case with the well-known nest of the chaffinch.

Sometimes the form of the nest is rather different from that which has been mentioned, and the structure is flask-shaped, the entrance corresponding to the neck of the flask. Now and then a nest is found in which there are two openings, one near the top in the usual position, and the other on the opposite side and near the bottom. The presence of one or two apertures is probably influenced by the position of the nest and the climate of the locality. If the finger be introduced into the aperture, a charmingly soft and warm bed of downy feathers is felt, *in* which, rather than *on* which, the numerous eggs repose.

The bird will build its nest in various trees, but always chooses a spot where the branches are very close and the foliage dense. The gorse bush is a favourite residence of the Long-tailed Titmouse, and so deeply is the nest buried in the prickly branches, that it cannot be removed without the aid of thick leather gloves, and a sharp, strong knife. Some skill and artistic taste are required in order to secure a good specimen, and it is difficult to hit the happy medium between cutting away too many branches, and retaining so many that the shape of the nest cannot be seen for their luxuriance. I may mention here that such nests are fertile homes of insects and various vermin, and that they ought to be placed in a box with spirits of turpentine for some weeks, and then exposed to strong heat, before the possessor can be sure that all existing insects are dead, and their eggs addled.

The number of eggs is rather variable, but is always great, and on an average, some ten or twelve eggs can be found in a nest. They are so small and so fragile that the novice finds great difficulty in emptying them

without breaking their delicate shells. This task may, however, be accomplished with perfect ease and safety if managed in the right way. Each egg should be enveloped in repeated wrappers of silver paper, soaked in a solution of gum arabic, one layer being allowed to dry before the next is added. When they are dry, a little hole is easily drilled on one side by means of a needle, the contents of the egg are then broken up with the same needle, and are then washed out by injecting water through a very delicate glass tube. Any one can make these slender tubes by merely taking a piece of ordinary glass tubing, heating it in a spirit lamp, and drawing the ends apart. It may then be broken off to form a tube of any degree of fineness, and by alternate injection of water and sucking the diluted contents into the tube, the egg will soon be emptied

We have another well-known bird, which makes a nest as well done as that of the long-tailed titmouse, though not nearly so pretty nor so elegant. This is the common MAGPIE, which is one of the very handsomest birds that are indigenous to England. Popularly, the Magpie is thought to be only black and white; in reality there is scarcely a black feather about the bird, its plumage being adorned with steel blue, green, and purple of such intensity that, in certain lights they appear to be jetty black. I may here mention that the wings and tail of the Magpie can be made into beautiful fire-screens, which are light and elegant as well as brilliantly coloured.

The nest of the Magpie is of very large size when compared with the dimensions of the architect, probably on account of the long tail of the mother bird, which cannot be protruded over the edge of the nest, as is the case with many long-tailed birds. It is not merely made of moss and similar soft substances, but

the framework is very strongly constructed of sticks, among which are generally interwoven a number of sharp thorns, so that the nest is nearly as unpleasant to the bare hand as a thistle. Moreover, the bird has a way of gathering the thorns round the entrance, so that the hand cannot be inserted into the nest without danger of many wounds. Indeed the nest is so large, and the eggs lie so far from the entrance, that to extract them is generally a task that cannot be accomplished without the aid of a knife.

Besides the thorny defence, the nest is mostly strengthened by its very position, being generally fixed in the furcation of several stout boughs, so that it can only be approached in certain parts. Moreover, the great height at which the Magpie loves to build the nest renders the operation of robbing it so dangerous, that many a nest escapes because no one has nerve enough to risk the ascent.

The position of the nest, too, conceals its true form so well, that a very practised eye is needed to distinguish it from an ordinary swelling of the bough, or from the heaps of dislodged twigs which are so often found in the forked branches of trees. Deserted nests are very common, and during my bird's-nesting days, I have frequently been disappointed to find that after all the trouble of ascending a lofty tree, the nest was empty, and had clearly been deserted for a year or two. Sometimes the nest is occupied by other creatures, and in some parts of the country, the pine marten has been known to take possession of a deserted Magpie's nest, and to lie therein quite unsuspected until driven out by some accident. Although a lofty tree is mostly chosen by the Magpie, such is not invariably the case, for now and then a low tree, or even a bush, is selected. In any case, however, the branches are sure to be thickly set, so that the nest may be firmly held among the boughs.

Another of our feathered dome-builders is the COMMON WREN. The form and colouring of this bird are too well known to need description, and we shall therefore pass at once to its mode of nesting.

The Wren is rather peculiar in its method of constructing the nest, for though it can build a dome when there is need for it, and generally does so, it does not always choose to take so much trouble, but contents itself with an open nest arched over by a natural dome. Wherever it can find a convenient cavity, it will make its nest therein, building either no dome at all, or one of very flimsy construction, and such nests can generally be found in the holes of ivy-covered walls, under eaves, or among the thickly growing branches of fir-trees.

During the time when the Wren is building its nest, its loud, cheerful voice is heard in full perfection, and so full and powerful are its tones that the tiny bird seems hardly able to produce them. It is but a short song, and is little varied, the bird repeating nearly the same melody time after time within a few minutes. The long-drawn song of the nightingale, or the mellow notes of the thrush, are beyond the power of the Wren, but there are few birds whose song is more enlivening, or which add so much to the pleasure of a country walk. Besides the more formal song, the Wren has a pretty little monosyllabic chirp, which it utters as it pops about the hedges with its peculiar movements, dropping and ascending again with restless activity. The bird is so bold, too, that it will perch on a branch or a paling within a yard or two of the observer, and pour forth its bright song without displaying the least alarm.

As to the materials of the nest, the bird is in no way fastidious, and generally seems to regard quantity rather than quality. Grasses of various kinds usually form the bulk of the nest, together with mosses, lichens, and similar substances. Withered leaves are generally

worked into the nest, and I have more than once found specimens which were almost wholly composed of leaves. The size of the nest is wonderfully large, when the dimensions of the tiny architect are taken into consideration, and however large may be the hole in which the Wren makes its nest, it is nearly filled with the mass of grass, leaves, and wool which the Wren has conveyed into it. The interior of the nest is always warmly lined, sometimes with feathers, and sometimes with hair, and in the lining are generally some six or eight little eggs, nearly white, and covered with very minute red specks.

Probably, the very large mass of material is employed in order to defend so small a bird from the inclemency of the season, for the Wren stays with us throughout the year, and in the winter time resides in the same nest which was used as a breeding-place during the summer. If an old ivy-covered wall, or a haystack, or an old house, be examined at night, there will often be found certain false nests in which the Wren hides itself. These curious edifices are raised by the Wren, though they are never used for the legitimate object of a nest, and the reason of their construction is not very evident. In all probability they are the work of young and inexperienced nest-builders, who begin to make their home, and when they have proceeded with their work, find that the locality is unsuitable, and that they must find another spot. The juvenile bird-nester is often woefully disappointed by finding these nests, especially if he finds three or four in a single wall or stack, as is not unfrequently the case.

As is the case with the redbreast and one or two of our more familiar birds, the Wren will sometimes enter houses and build its nest in curtains, on shelves, and similar localities, while the interior of a disused greenhouse or stable loft is nearly sure to be tenanted by a Wren and its little brood.

An allied bird, the HOUSE WREN of Northern America, has very much the same habits, and will generally take possession of any box that is nailed on a wall, or a post where a cat cannot reach it. On account of, probably, the bird-eating snakes, which are plentiful in that country, the materials of the nest are much stronger than in England, and consist generally of twigs and sticks on the exterior and feathers within. Wilson mentions that on a hot June day, a mower happened to hang up his coat in a shed, and left it there for two or three days. When he removed it from the nail on which it had hung, and was putting it on, he found one of the sleeves quite choked up with sticks, grass, and feathers, being the completed nest of a House Wren. The unfortunate little architects were very angry with the man for disturbing their home, and followed him out of the shed, scolding him for the damage which he had unwittingly done to their newly-finished home.

Happily for the little bird, the popular feeling is in favour of its preservation, and in many a garden there is a box for the House Wren, carefully mounted on a pole like one of our barrel pigeon-cotes, and each box having only a little hole by way of entrance, so that no larger and more powerful bird should be able to usurp the comfortable little house. In default of a box, however, the House Wren will put up with very poor accommodation, and make its nest in an old hat nailed under the eaves of a house, or in a flower-pot, or in a hollow cocoa-nut or gourd. There is wisdom as well as kindness in providing a home for the House Wren, for it is one of the insect-eating birds, and when it is thus suited with a house, it remains near the spot, to the manifest advantage of the herbs and fruit.

Of this little bird Wilson gives an interesting anecdote. "A box fixed up in the window of the room where

I slept was taken possession of by a pair of Wrens. Already the nest was built and two eggs laid, when one day, the window being open, as well as the room door, the female Wren, venturing too far into the room to reconnoitre, was sprung upon by grimalkin, who had planted herself there for the purpose, and before relief could be given, was destroyed. Curious to see how the survivor would demean himself, I watched him carefully for several days.

"At first he sang with great vivacity for an hour or so, but becoming weary, went off for half an hour; on his return he chanted again as before, went to the top of the house, stable, and weeping-willow, that she might hear him. But, seeing no appearance of her, he returned once more, visited the nest, ventured cautiously into the window, and gazed about with suspicious looks, his voice sinking to a low, melancholy note as he stretched his little neck about in every direction. Returning to the box, he seemed for some minutes at a loss what to do, and soon after went off as I thought altogether, for I saw him no more that day.

"Towards the afternoon of the second day, he again made his appearance, accompanied by a new female, who seemed exceedingly timid and shy, and who, after great hesitation, entered the box; at this moment the little widower or bridegroom seemed as if he would warble out his very life with ecstasy of joy. After remaining about half a minute in, they both flew off, but returned in a few minutes, and instantly began to carry out the eggs, feathers, and some of the sticks, supplying the place of the latter with materials of the same sort; and ultimately they succeeded in raising a brood of seven young, all of which escaped in safety."

In this little narrative there are two curious points to be noticed, the one that the eggs already laid were

turned out, and the other that the new mistress of the house, with a natural jealousy of her predecessor, rearranged the interior, so as to suit her own ideas of good taste.

As the bird is so useful, the proprietors of gardens would be glad to have a number of families in their domains. This plan, however admirable in theory, is found to be impracticable in fact, the quarrelsome nature of the bird enduring no rival. During the building season, the House Wren sings, fights, and builds with equal energy, and drives away birds of three times his size. The woodpecker is obliged to quit so disturbed a spot, the fussy and active titmice yield to the Wren, and even the blue bird itself, which is also a favourite inmate of the garden, and is furnished with breeding boxes, is obliged to retire from the field, and to allow its tiny antagonist the choice of houses.

Australia is proverbially a strange land, and it is only in Australia, or perhaps in Madagascar, that we should look for a Wren measuring some seventeen inches in height. Such a bird is, however, to be found in Australia, and is known to the natives by the name of BULLEN-BULLEN, and to the Europeans as the LYRE BIRD. It is remarkable, by the way, that the genius of the Australian language causes many words to be doubled, so that the natives speak of a well known Australian marsupial as the devil-devil, and of a domestic servant as Jacky-Jacky.

New South Wales is the chosen country of the Lyre Bird, which is rather local, and affects certain defined boundaries. Its native name is derived from its peculiar cry, and the popular European name is given to the bird on account of the shape of its tail feathers. The two exterior feathers are curved in such a manner, that when the whole tail is spread they exactly resemble the horns of an ancient lyre, the place of the strings being

taken by a number of slender decomposed feathers which rise from the centre of the tail. When the bird is quietly at rest, the tail-feathers cross each other at the curves, and present a very elegant appearance, though not in the least resembling a lyre. In general shape the bird bears some resemblance to a small turkey, except that the legs are longer and more slender, and that the feet do not resemble those of a gallinaceous bird. It is rather remarkable that the egg presents as curious a mixture of the insessorial and gallinaceous aspects as the bird itself.

The nest of this bird is not at all unlike that of the wren, being very much of the same shape, and domed after a similar fashion. The nest is, however, a very rough piece of architecture, composed almost wholly of twigs, roots, and various sticks, which are interwoven in a very loose, but very ingenious manner, so as to form a structure of tolerable firmness, which can be lifted and even subjected to rough treatment without being broken. At first sight it looks like those heaps of dead twigs which are so common in the birch-tree, but a closer inspection shows that there is a certain regularity in the disposition of the sticks, and that the bird is not without method, though that method be not at first apparent.

So rude a structure as this nest would be unsuitable for the tender young, and therefore the whole of the interior is stuffed full of soft feathers. The nest of an allied species, ALBERT LYRE BIRD, is made in a similar manner, except that the materials are almost wholly small and rather long sticks. Specimens of these nests may be seen in the British Museum. Both these birds are very shy, and cannot be approached without the greatest caution. Like the gallinaceous birds, to which they bear a strong resemblance, they are fond of scratching large holes in sandy soil, sometimes making them nearly a yard in width and eighteen or twenty inches in depth.

In the "corrobororing" places, as the natives call them, the Lyre Bird is mostly to be found, and the experienced hunter always watches for the disappearance of the bird into the hole to make his advance. Every now and then it jumps out of the hole, and struts about, mocking with wonderful facility the notes of various other birds, and even imitating precisely those of the laughing jackass. It has, however, a very sweet and powerful note of its own. Each bird makes three or four of these corrobororing places, sometimes at a distance of three or four hundred yards from each other.

Dr. Stephenson thinks that the corrobororing places are not merely made for amusement, but that they are used as traps in which are caught sundry beetles and other insects, which fall into the pits and cannot get out again. Should this ingenious theory be true, the Lyre bird and the ant-lion have a similar method of trapping their prey in sandy pitfalls, though the former is a bird, and the latter an immature insect.

Our last example of the Building Birds will be the well-known BOWER BIRD of Australia.

Perhaps the whole range of ornithology does not produce a more singular phenomenon than the fact of a bird building a house merely for amusement, and decorating it with brilliant objects as if to mark its destination. Such a proceeding marks a great progress in civilisation, even among human races. The savage, pure and simple, has no notion of undergoing more labour than can be avoided, and thinks that setting his wives to build a hut is quite as much labour as he chooses to endure.

The native Australians have no places of amusement. They will certainly dance their corrobory in one part of the forest in preference to another, but merely because the spot happens to be suitable without the expenditure of manual labour. The Bushman has no

place of resort, neither has the much farther advanced Zulu Kafir. Even the New Zealander, who is the most favourable example of a savage, does not erect a building merely for the purpose of amusement, and would perhaps fail to comprehend that such an edifice could be needed. Such a task is left to the civilised races, and it is somewhat startling to find that in erecting a ball-room, or an assembly-room, or any similar building, we have been long anticipated by a bird which was unknown until within the last few years Truly, nothing is new under the sun.

The ball-room, or "bower," which this bird builds is a very remarkable erection. Its general form can be seen by reference to the illustration, but the method by which it is constructed can only be learned by watching the feathered architect at work Fortunately there are several specimens of this bird at the Zoological Gardens, and I have often been much interested in seeing the bird engaged in its labours

Whether it works smartly or not in its native land I cannot say, but it certainly does not hurry itself in this country. It begins by weaving a tolerably firm platform of small twigs, which looks as if the bird had been trying to make a door mat and had nearly succeeded. It then looks for some long and rather slender twigs, and pushes their bases into the platform, working them tightly into its substance, and giving them such an inward inclination that, when they are fixed at opposite sides of the platform, their tips cross each other, and form a simple arch. As these twigs are set along the platform on both sides the bird gradually makes an arched alley, extending variably both in length and height.

When the bower is completed, the reader may well ask the use to which it can be put. It is not a nest, and I believe that the real nest of this bird has not yet been discovered. It serves as an assembly-room, in which a

number of birds take their amusement. Not only do the architects use it, but many birds of both sexes resort to



THE BOWER BIRD

it, and continually run through and round it, chasing one another in a very sportive fashion

While they are thus amusing themselves, they utter a curious, deep, and rather resonant note. Indeed, my attention was first attracted to the living Bower Bird by this note. One day as I was passing the great aviary in the Zoological Gardens, I was startled by a note with which I was quite unacquainted, and which I thought must have issued from the mouth of a parrot. Presently, however, I saw a very glossy bird, of a deep purple hue, running about, and occasionally uttering the sound which had attracted me. Soon, it was evident that this was a Bower Bird engaged in building the assembly-room, and after a little while he became reconciled to my presence, and proceeded with his work. He went about it in a leisurely and reflective manner, taking plenty of time over his work, and disdaining to hurry himself.

First he would go off to the further end of the compartment, and there inspect a quantity of twigs which had been put there for his use. After contemplating them for some time, he would take up a twig and then drop it as if it were too hot to hold. Perhaps he would repeat this process six or seven times with the same twig, and then suddenly pounce on another, weigh it once or twice in his beak, and carry it off. When he reached the bower he still kept up his leisurely character, for he would perambulate the floor for some minutes, with the twig still in his beak, and then perhaps would lay it down, turn in another direction, and look as if he had forgotten about it. Sooner or later, however, the twig was fixed, and then he would run through the bower several times, utter his loud cry, and start off for another twig.

Why these birds should trouble themselves to make this bower is a problem as yet unsolved. Had the structure served in any way as a protection from the weather, there would have been a self-evident reason for its existence, but the arching twigs are put together

so loosely that they cannot protect the birds from wind or rain. Whatever may be the object of the bower, the birds are so fond of it that they resort to it during many hours of the day, and a good bower is seldom left without a temporary occupant.

Ornament is also employed by the Bower Bird, both entrances of the bower being decorated with bright and shining objects. The bird is not in the least fastidious about the articles with which it decorates its bower, provided only that they shine and are conspicuous. Scraps of coloured ribbon, shells, bits of paper, teeth, bones, broken glass and china, feathers, and similar articles, are in great request, and such objects as a lady's thimble, a tobacco-pipe, and a tomahawk have been found near one of their bowers. Indeed, whenever the natives lose any small and tolerably portable object, they always search the bowers of the neighbourhood, and frequently find that the missing article is doing duty as decoration to the edifice.

This species is more plentiful than another Bower Bird which will presently be described. As is the case with many birds, the adult male is very different from the young male and the female in his colouring. His plumage is a rich, deep purple, so deep indeed as to appear black when the bird is standing in the shade. It is of a close texture, and glossy as if made of satin, presenting a lovely appearance when the bird runs about in the sunbeams. The specific name, *holosericeus*, is composed of two Greek words signifying all silken, and is very appropriate to the species. The female is not in the least like the male, her plumage being almost uniform olive green, and the young male is coloured in a similar manner.

Another species of Bower Bird inhabits New South Wales, and on account of its variegated plumage is called the SPOTTED BOWER BIRD.

The bower which is built by this bird is of very great comparative size, being sometimes a full yard in length, and the arches higher than those of the previous species. Long grass is plentifully interwoven among the twigs, and the decorations of stones, shells, and feathers extend to a considerable distance from either end of the bower. Mr. Gould mentions that the bird places the heaviest stones so as to keep the twigs in their places, and that it will even bring the skulls and bones of the small mammalia to aid in the decoration of its bower.

These birds are allied to the common starling, and belong to a small group of that family which have gained the name of Glossy Starlings on account of their satin-like plumage.

The colour of the Spotted Bower Bird is warm brown, profusely spotted with buff, and upon the back of the neck there is a kind of falling ruff or collar of long feathers which shine like spun glass, and are of a lovely rose pink colour. The generic name "Chlamydera" literally signifies "cloak necked," and is given to the bird on account of this peculiarity. The classical reader will remember that the chlamys was a short cloak or scarf, that could be thrown round the neck or over the shoulder at the convenience of the wearer.

## CHAPTER IX

*BUILDING INSECTS.*

The TERMITE, or WHITE ANT—General habits of the insect—African Termites, and their homes—Termites as articles of food—Indian Termites—Account of their proceedings—American Termites—Mr Bates' account of their habits—European Termites—Their ravages in France and Spain—M de Quatrefages and his history of the Termites of Rochefort and La Rochelle—The EUMENES and its mud-built nest—The TRYPOXYLON of South America—The PELOPOEUS and its curious nest—The MUD-DAUBER WASP—Mr Goss's account of its habits—The MELIPONA of America—Mr Stone's Wasp nests and their history—Difference of material—The FORAGING ANTS of South America and their various species—Nests and habits of the Foraging Ants—The AGRICULTURAL ANT of Texas—Dr Lincecum's accounts of its habits.

WE now pass to the many insects which may be classed among the Builders.

Of the Building insects the TERMITE, or WHITE ANT, as it is popularly and wrongly called, is the acknowledged head and chief. There are certain other insects that erect habitations which are truly wonderful, but there is not one that approaches the Termite in the size of its building or the stone-like solidity of the structure.

If the reader will refer to the large illustration, he will see that the Termite of Southern Africa can erect nests of very great size. Three of these

structures are shown, and a human being has been introduced by one of them in order to show their average height.

The history of the Termites is so complicated, and so full of incident, that I might occupy several hundred pages of this work in describing them and their nests, and yet not have exhausted the subject. I shall, therefore, give a general sketch of the Termites and their habits, and then relate a few details concerning the species which are found in Africa, Asia, America, and Europe.

In the first place, the reader must understand that the Termite is not an ant at all, but belongs to a totally different order of insect, and is allied to the dragon-flies, the ant-lions, the May-flies, and the beautiful Lace-wing flies.

The Termites are social, and, like other social insects, are divided into several grades, such as workers, males, and females, the two latter of which are winged when they reach maturity. The body is oblong and flat, the antennæ short, and the mandibles flattened and toothed, and in most cases extremely long and formidable. Each colony is founded by a single pair, popularly called the king and queen, the rest of the population consisting of developed males and females, which are intended to perpetuate the species and found fresh colonies, and of undeveloped individuals, or neuters, of both sexes.

The neuter males are termed soldiers, and are armed with powerful jaws proceeding from enormous heads, and the neuter females are termed workers, and are very small.

There are now before me some specimens of African Termites, the soldiers of which are five or six times as large as the workers. They are formidable creatures, but they can do little harm beyond inflicting a severe bite, as they are not furnished with stings nor even



NEST OF TERMITES, AFRICA

with poison glands. They can bite through the clothes of an European, and when they swarm upon the bare limbs of the negro, they inflict almost unbearable tortures. The chief duty of the soldier seems to be the defence of the nest; for whenever the walls are broken down the soldiers come trooping out to attack the invader, and being quite unconscious of fear, they will seize on the first strange object that happens to come in their way. There are comparatively few soldiers, their proportion to the workers being only one per cent.

When a pair of developed Termites have settled themselves to form a colony, they share the fate of certain Oriental potentates, and never move out of their royal cell. When the queen is fairly settled, she increases in size so rapidly, that, even if she were set at liberty, she could not crawl an inch. While the head, thorax, and legs retain their original dimensions, the abdomen swells until it is more than two inches long and about three quarters of an inch in width. Thus developed, she produces eggs by the thousand, which are immediately carried off by the workers, who have reserved certain apertures in the royal apartment through which they can easily pass. When the eggs are hatched, the young are carefully watched and tended until they are at last developed into males, females, or neuters, and themselves are able to take part in the manual work.

A full-sized nest of the African Termite is a wonderful structure. Although made merely of clay, the walls are nearly as hard as stone, and quite as hard as the brick of which "villa residences" are usually built. The form of the nest is essentially conical, a large cone occupying the centre, and smaller cones being grouped round it, like pinnacles round a Gothic spire.

In Anderson's valuable work, "Lake Ngami," there are many detached accounts of the African Termite.

He states that he has seen nests which were full twenty feet in height, and had a circumference of a hundred feet, and that when the insects were developed and obtained their wings, they issued forth in such hosts that the air seemed as if it were filled with dense and white snow flakes. So strong is the instinct for rushing into the air, that they can scarcely be retained within the nest, and will even pass through fire in order to gain their end.

The nests are always interesting objects, even from the exterior. The walls are so hard that hunters are accustomed to mount upon them for the purpose of looking out for game, and the wild buffalo has a similar habit, the structure being strong enough even to support the weight of so large an animal. The daily labours of the architects can easily be traced, on account of the dampness of the recent clay, so that an approximation can be formed as to the length of time which is occupied in erecting one of the nests. The traveller is always glad to see a large Termite nest, because he is nearly sure to find the surface studded with mushrooms, which are larger and better flavoured than those which our fields produce.

The natives have another motive for looking after the Termite nests, because they eat the inmates, considering them to be a peculiar luxury. The same author whom I have already mentioned, describes a curious interview that he had with Palani, a Bayeiye chief.

Wishing to show the chief the superiority of European cookery, Mr. Anderson spread some apricot jam on bread, and offered it to him. The chief took it, and expressed himself much pleased with it, but asserted that Termites were much superior in flavour. In order to catch the Termites in sufficient numbers, the native makes a hole in the nest, and when the workers are congregated for the purpose of repairing the breach,

he sweeps them into a vessel, and repeats the operation until he has obtained as many as he wants.

As is the case with the true ants, the Termites only retain their wings for a limited period, using them for the purpose of escaping from the nest, and snapping them off as soon as they have met with a partner. The manner in which the wings are fixed to the body is the same in both groups of insects, and these singular organs are shed by being bent sharply forwards. If a living Termite be caught, and its wings pressed forward with a pin, they will instantly snap off; but if bent backwards, a piece of the body will be torn away before the wings can be removed.

A correspondent of the *Field* newspaper gives a very interesting account of the proceedings of the Termites living in India. After mentioning the peculiar shedding of the wings, he writes as follows:—

"The career of the winged white ant, as far as I have had an opportunity of judging, is as follows:—Soon after the commencement of the first shower which ushers in the rainy season in India, swarms of winged white ants are to be seen issuing from small holes in the earth, in old mud or sunburnt brick walls, and from places of a similar character, in which the original nests may have been located whence these swarms are thrown off. These legions at once attract the attention of all the insectivorous and omnivorous birds in the neighbourhood, and the minahs, crows, and sparrows are on the alert to feast to satiety on the defenceless ants.

"Judging from the appearance of the wings of these ants as they emerge from their earth-home, I should be disposed to think that they do not develop their wings until the dampness of the atmosphere warns them to prepare for action. There is a new, smooth, and glossy appearance about them, not unlike the wings of a young wasp, or the shine of a new hat. The ants vary much in size at this period of their existence;

in good damp seasons, and perhaps in favourable localities, they have a well-fed, plump appearance, whereas under unfavourable circumstances they present a slender and measly complexion. They crawl to the mouth of the hole in the first instance, and at once take wing. The males and females take no particular notice of each other until they have made their preliminary flight, which is but short; they soon alight on the ground, or on the dinner-table, as the case may be, making direct for a light if their flight is after dark.

"As soon as they obtain a footing after their descent from their aerial expedition, both males and females commence to run a most headlong and reckless career. Nothing appears to arrest their progress. The female, who is larger and more full in figure than the male, is also slower in her movements. She stops from time to time and performs slow and singular contortions with the hinder portion of her body. I can't help thinking that she gives out some peculiar odour at these times—at all events the males are sensible of the scent of the females, and if they, in their more rapid quartering of the ground, pass over the track of a female, their excitement and activity is redoubled, and they take up the running with singular pertinacity.

"Up to this point both male and female ant retain their wings, and it is as difficult to deprive them of these members as it is to pull the wings from a house-fly. No sooner, however, does the male ant overtake the female, than he makes a dash at the but-too-willing flirt, and seizes (gently, I presume) the extreme end of her plump figure with his jaws. This is the signal to the female that she no longer requires her wings, and at once, with a jerk, both male and female throw from them these now useless incumbrances. Away they go, madam towing my lord, who never quits his hold, but clings to the skirts of his ladylove in a most gallant manner. They race over stock and stone, over garden walk.

verandah, or dinner-table, as the case may be, until they jointly fall victims to the ever-watchful birds, beasts, or fishes, who are all on the *qui vive* for the dainty morsel.

"Should they escape all their numerous enemies, and not succeed in being swept from the table by the ever-watchful kitmutgar, the female soon selects for her home, in which to spend the honeymoon of her existence, some spot which seems adapted for the end which she has in view. If she is a prudent, cautious dame, she picks out some soft nodule of earth moistened by the recent rain, and having done so, she communicates to her lord and follower by some means, which to me are inscrutable, that she thinks the lodgings will do.

"The worthy gentleman at once casts off the tow-line, and he and the lady of his affections buckle to without loss of time, and excavate a home for the comfortable reception of the lady. White ants are put to sad shifts at these times. Any dark nook brings them to a halt, and the lea-side of a plate, tray, or the shady side of a candlestick is often selected by the confiding female. In all her arrangements the male appears to acquiesce without demur.

"Vanity and vexation are the natural results of such ill-considered domestic arrangements, and the expiring couple, exhausted with their endeavours to make an earthen nest out of a bamboo tray and a cotton table-cloth, are scattered to the winds by the first servant who may be pleased to screw up energy sufficient to remove the *debris* of the evening meal, to make wags: master's breakfast next day. Of the subsequent movements, I, or the happy couple it is out of my power to develop, never having had an opportunity of carefully observing their movements."

mation may be obtained from Mr. Bates' valuable work on the natural history of the Amazons. As many of his remarks simply prove the identity of habits between the Termites of the old world and those of the new, I shall say nothing about them, but merely give a brief abstract of his observations.

As with the species which have already been described, the soldiers are the only individuals that fight. When, therefore, the ant-bear tears down the walls of the nest and begins to lick up the inmates, none but the soldiers are killed, they having come out to fight the enemy, while the workers have all run away and hidden themselves underground. In consequence of this fact, the economy of the nest is but slightly disturbed, and after the ant-bear has gone away, the workers begin to raise their walls afresh.

It must be remembered that the nests of the Termite are not confined to the surface, but extend to a considerable distance in the earth, the subterranean galleries being proportionately large to the superimposed nest. Indeed, the greater part of the material with which the walls and galleries are built is brought from below and carried upwards through the nest itself. There is no visible outlet to a Termite's nest, because the insects construct long galleries through which they can pass without suffering inconvenience from the light of day. Both the workers and soldiers are blind; but, in spite of the absence of external visual organs, they are very sensitive to light, and avoid it in every possible way.

The food of the Termite is of a vegetable character, and consists mostly of wooden fibres. They will, however, eat almost anything, and the traveller in hot climates among his worst troubles. They will eat a mat on which a man is lying. All the wood of his strong box, thicker than the paper on

which this account is printed. They will devour all his collection of plants, beasts, birds and insects; and a table or any other article of furniture, if left too long in one position, will be utterly ruined by the Termites, which have a fashion of eating away all the interior, but leaving just a thin shell, which looks as if nothing were the matter.

Exterminating them is a difficult task. It is true that, if the mats, clothes, and other household goods are washed with a solution of corrosive sublimate, the Termites will not touch them; but as the articles which can be thus protected are necessarily few in number, the best method is to extirpate them. This can only be done by going to the fountain-head, and cutting off the supply. It is useless to destroy the workers or soldiers, for they are replaced as fast as killed. But, if the queen be destroyed, the supply of eggs is at once stopped, the subjects lose heart, and the colony dies off.

When the adult Termites leave their homes, they often fly in such clouds that they fill the rooms, and even put out the lamps by their numbers. As soon as they touch ground they shed their wings, and then they begin to find how many enemies they have. Of the myriad hosts that pour into the evening air, not one in twenty thousand survives to found a new colony. They have foes above, below, and on every side. The bats and goat-suckers hold high festival on these evenings when the Termites are abroad, and after the insects have cast their wings they are pursued by ants, toads, spiders, and a host of other enemies.

We will now pass to the European *Termes*, whose history is elaborately given by M de Quatrefages, at Rochefort, Saintes, and Tournay-Charente by speaking the years suffered from the ravages of the Ty watchin<sup>g</sup> w La Rochelle is invaded by these ter<sup>n</sup> all probability they were import<sup>t</sup>

ashore in the boxes into which they had penetrated, and thence spread into the country around. Efforts are being made towards the extirpation of these terrible insects, but nothing seems as yet to have had any great effect. How serious are the damages which they work may be seen from the following account by M. de Quatrefages, in his "Rambles of a Naturalist," vol. ii. p 346:—

"The Prefecture and a few neighbouring houses are the principal scene of the destructive ravages of the Termites, but here they have taken complete possession of the premises. In the garden, not a stake can be put into the ground, and not a plank can be left on the beds, without being attacked within twenty-four hours. The fences put round the young trees are gnawed from the bottom, while the trees themselves are gutted to the very branches.

"Within the building itself, the apartments and offices are alike invaded. I saw upon the roof of a bedroom that had been recently repaired, galleries made by the Termites which looked like stalactites, and which had begun to show themselves the very day after the workmen had left the place. In the cellars I discovered similar galleries, which were within half-way between the ceiling and the floor, or running along the walls and extending no doubt up to the very garrets; for on the principal staircase other galleries were observed between the ground-floor and the second floor, passing under the plaster wherever it was sufficiently thick for the purpose, and only coming to view at different points where the stones were on the surface, for, like other species, the Termites of La Rochelle always work under cover wherever it is possible for them to do so.

"M. Milne-Edwards and Blanchard have seen galleries which descended without any extraneous support from the ceiling to the floor of a cellar. M. Bobe-Moreau cites several curious instances of this mode of construc-

tion. Thus, for instance, he saw isolated galleries or arcades, which were thrown horizontally forward like a tubular bridge, in order to reach a piece of paper that was wrapped round a bottle, the contents of a pot of honey, &c.

"It is generally only by incessant vigilance that we can trace the course of their devastations and prevent their ravages. At the time of M. Audoin's visit a curious proof was accidentally obtained of the mischief which this insect silently accomplishes. One day it was discovered that the archives of the Department were almost totally destroyed, and that without the slightest external trace of any damage. The Termites had reached the boxes in which these documents were preserved by mining the wainscoting; and they had then leisurely set to work to devour these administrative records, carefully respecting the upper sheets and the margin of each leaf, so that a box, which was only a mass of rubbish, seemed to contain a pile of papers in perfect order."

In the British Museum are several examples of the ravages worked by Termites, one of which is an ordinary beam that has been so completely hollowed and eaten away, that nothing remains but a mere shell no thicker than the wood of a bandbox.

As the limits of the work preclude a very lengthened account of any one creature, our history of the Termites must here be concluded, although much interesting matter remains unwritten.

In the accompanying illustration are shown two nests, the two upper specimens on the right hand having been already described. They are made by the little spider called *Agelena brunnea*.

The two lower nests are made by a species of solitary wasp, which has no popular name, but is known to entomologists as *Eumenes coarctata*. It is not a large insect,

the female being only half an inch in length, and the male rather smaller. The general colour is black, with a fine velvet-like pile on the abdomen, and relieved by lines and spots of yellow. The abdomen is small, and set on a rather short and pear-shaped footstalk, as may be seen by the illustration, which represents the insect of its natural size.



EUMENES AND AGELENA.

This is one of the species which are tolerably common in certain localities, but as they are very local, may be reckoned among the varieties. Mr. F. Smith, in his "Catalogue of the British Vespidæ," mentions that it has been taken in several parts of Hampshire, Berkshire, near Weybridge, and has been found plentifully at Sun-

ninghill. Probably, the rarity or frequency of this species, as is the case with many others, depends greatly on the eyes which look after it.

This little wasp constructs small globular cells of mud, and fastens them to the stems of various plants, the common heath being the greatest favourite, so that heath-covered commons are likely to afford specimens of the nest and its architect. Each nest contains only a single cell, and is only intended to rear a single occupant. The wasp is a very useful insect, as it provisions its nest with the larvæ of small lepidoptera, each Eumenes grub requiring a tolerably large supply of caterpillars.

As is the case with so many insects, the Eumenes is greatly subject to the attacks of parasites, which contrive to deposit their eggs in the larvæ in spite of the hard mud walls of the cell. Mr. Smith mentions that he has bred, from the nest of the Eumenes, an ichneumon fly belonging to the genus *Cryptus*.

In the accompanying illustration are figured the nests of two insects, both of them natives of tropical America, and both belonging to the hymenopterous order. The upper insect is known to entomologists by the name of *Trypoxylon aurifrons*, but has at present no popular name.

This insect makes a great number of earthen cells, shaped something like those of the last-mentioned species; the cells being remarkable for the form of the entrance, which is narrowed and rounded as shown in the figure.

In some cases the neck is so very narrow in proportion to the size of the cell, and the rim is so neatly turned over, that the observer is irresistibly reminded of the neck of a glass bottle. The insect makes quite a number of these nests, sometimes fastening them to branches, as shown in the illustration, but as frequently fixing them to beams of

houses. It has a great fancy for the corners of verandahs, and builds therein whole rows of cells, buzzing loudly the while, and attracting attention by the noise which it makes.

The lower insect is the pretty *Pelopæus fistularis*, with



TRYPOXYLON AND PEL

its yellow and black banded body. Both the insects, as well as their houses, are represented of the natural size.

The cell of the *Pelopæus* is larger than that of the preceding insect, and occupies much more time in the construction, a week at least being devoted to the task. She sets to work very methodically, taking a

long time in kneading the clay, which she rolls into little spherical pellets, and kneads for a minute or two before she leaves the ground. She then flies away with her load, and adds it to the nest, spreading the clay in a series of rings, like the courses of bricks in a circular chimney, so that the edifice soon assumes a rudely cylindrical form.

When she has nearly completed her task, she goes off in search of creatures wherewith to stock the nest, and to serve as food for the young, and selects about the most unpromising specimens that can be conceived. Like many other solitary hymenoptera, this *Pelopaeus* stores her nest with spiders, and any one would suppose that she would choose the softest and the plumpest kinds for her young. It is found, however, that she acts precisely in the opposite manner.

In tropical America there is a large group of spiders allied to the common garden spider, but of the most extraordinary shapes and colours. They all possess a hard, shelly covering, polished and shining like that of many beetles, and glittering with bright and radiant hues—blue, crimson, green, and purple being the colours with which they are ordinarily decorated. Their forms are, however, even more remarkable than their colours. The hard and shelly covering is not uniform and smooth, but shoots out into the most extraordinary projections, giving to the creatures a wild and fantastic grotesqueness of aspect, that surpasses even the weird imaginings of Breughel, Cranagh, Callot, and other masters of diablerie in art.

One genus has the abdomen formed in a drum shape, the sides and extremity being covered with short, sharp, and stout spines. Another has the abdomen modified into a ball-like shape, from which radiate sharp spikes, like those of the well-known "calthrop;" while in another genus certain enormous projections issue from the abdomen, two being so large that in volume they

exceed the whole of the abdomen and body. In one species they are thick, solid, and palmated, like the horns of the elk; in another they are slender, and curved like the horns of a bull, and there are other species quite as bizarre in form. It is from these creatures, more especially from the first-mentioned, that the Pelopaeus selects her victims, and it is evident that the jaws of the young Pelopaeus must be exceedingly strong to be enabled to pierce their hard and well-armed bodies. Like the previously-mentioned insect, the Pelopaeus makes a loud and cheerful buzzing while engaged in her work of building.

Mr. Bates, who has described these two insects, has likewise mentioned a builder insect of the same order, called *Melipona fasciculata*. The genus to which this insect belongs is a very large one, containing some forty-five species, some of which are very common in woods, and being extremely small, measuring only the twelfth of an inch in length, they are very annoying to the traveller, getting into his nostrils and worrying him in various ways. Fortunately, they do not sting, but their bite is very sharp, and if made on a sensitive surface like the lining membrane of the nostril, can inflict very severe pain.

The form of habitation is various, according to the species, but they all use clay for that purpose, kneading it with their mandibles, and then passing it to the hind legs and pressing it into the hair-fringed depression which is popularly called the basket. Some species are accustomed to employ any casual crevice as a nest, stuffing it up with clay and leaving only a little orifice through which they can pass. Others again make long tubes of clay, with trumpet-shaped mouths, and it is a remarkable fact that a number of the bees are always at the entrance as sentinels, just as is the case with the hive bee when wasps are abroad.

In the "Zoologist," for 1864, p. 582, is a very interesting description, by Mr. P. H. Gosse, of the proceedings of insects which he appropriately calls the DAUBER WASPS, and which belong to the same genus as the *Pelopaeus* mentioned above. One insect he identifies as *Pelopaeus flavipes*, and the other is probably *Pelopaeus spirifer*. One of these insects is now before me, and a very pretty creature it is. In shape it exactly resembles that which is figured on page 213, but the colours are different. The general hue is deep brown-black, very shining in the abdomen, and softened by thick down upon the thorax. It is, however, not a sombre insect, as the long footstalk of the abdomen is bright yellow, and the limbs are banded with the same lively hue. I strongly advise my readers to peruse this account, because it is full of detail, and contains much useful information about the method of working adopted by the insect, thus giving a clue to the proceedings of other insects which build habitations of similar materials. The length of the account is the reason why it cannot be transferred to these pages, and I must, therefore, give a short abstract.

Having seen many patches of a yellow mud on the walls and rafters, some as large as the closed fist and others of comparatively small dimensions, he asked some boys what they were, and was told that they were the nests of the Dirt-daubers. Finding that as the weather became warm the insects began to build, he set to work and watched them carefully. First he tried their sagacity by boring holes in their cells, in order to see whether the insects would fill them up, and afterwards by inserting foreign substances, such as a tin-tack and a piece of worsted, into the cell. The insect proved herself equal to the occasion, filled up the holes, and pulled out both the tack and the worsted. The next point was, to watch a nest from its foundation, and to see how it was built. The insect always went off, was absent for about a minute, and then returned, bearing in her jaws a lump

of clay larger than her own head. The clay was perfectly plastic, and could be spread at once. The method by which the cell is formed must be given in the author's own words:—

"About this time (August 18) the other species of *Pelopaeus* began to be busy fabricating their artful thimble-shaped nests.

"It is difficult to convey by words an idea of their mode of working. The commencement of a cell was by laying down the load and working it into an oval ridge, one extremity of which was to be the apex of the thimble cell. The next load was laid on the ridge, but so as to be higher at the apex than at any other part, and made slightly concave. When the top was made, the work proceeded regularly by additions to the edges, which were smoothly laid on, and always in the same slanting direction that had been given at first, by raising one end of the incipient oval, so that an unfinished cell in any state of progress appears to be a cylinder cut off by a diagonal section.

"This is not casual but invariable, as the ridges remaining plainly mark the precise limits of every load.

"When a little more in length is finished than suffices for a single cell, the work ceases for awhile, an egg is laid in the bottom, though this end is generally uppermost, and spiders are brought in. This species usually, not always, selects a very beautiful species of *Tetragnatha*, bright green with white spots; and it is worth remarking that spiders are carried both with the jaws and feet, one of the forelegs of the spider being grasped in the mouth, while the body is held under that of the fly, and sustained by the anterior and middle legs and feet, the posterior pair being extended behind, as usual during flight.

"When the first cell is stocked, it is closed up by a transverse partition of mud, and the thimble goes on increasing as before. When finished, one will contain

three or even four cells, and then a new one is commenced, adjoining and parallel with it. In both this and the other species, I believe that the enclosed grub eats only the abdomen of the spiders (which are so stung as to be helpless but not dead) as the cephalothorax and legs of each may generally be found afterwards in the cell."

The same writer noticed a remarkable instance of ingenuity in these insects. An empty ink-bottle about an inch and a half in length lay on the table. The neck of this bottle was one day seen to be stopped up with a substance like white pipe-clay, and when this was broken, the bottle was found to be stored with spiders. The fact was, that a *Pelopaeus* had spied out the bottle, and thought that she had a fine opportunity of providing a home for her young without troubling herself to build a regular nest. A day or two afterwards, the Dauber returned to see after the nest, and finding that it had been disturbed, she entered the bottle, took out all the spiders, replaced them with fresh specimens, and then re-closed the mouth. It is evident from this fact, that the insect does not entirely abandon her young when she has completed and closed the nest.

Another curious discovery was also made while watching the *Pelopaeus*. If the reader will refer to the illustration, he will see that the abdomen of the insect is supported on a very long and slender peduncle, or foot-stalk. Mr. Gosse was naturally anxious to discover how the insect could draw the abdomen out of the pupal skin when it came to change into its perfect condition. On examining some specimens, he discovered the curious fact, that the pupal envelope did not sit closely to the body, but that it was as wide in the middle as at either end, so that when the insect came to assume its perfect form, the peduncle was quite loose in the centre of the envelope, and the abdomen could be drawn out without any difficulty.

These observations are peculiarly valuable, because

they set at rest a question which was raised by several entomologists, who thought that the nests were made by some species of eumenes, and that the Pelopaeus was a mere parasite upon them, like the cryptus, and many other of the ichneumonidæ.

If the reader will refer to the four illustrations on the following pages entitled "Mr. Stone's Wasps' Nests," he will see representations of four square boxes, each containing an object which would hardly be taken for a wasp's nest at a little distance. Such, however, is the case; and these boxes are four selected examples out of a series of six which were built in Mr. Stone's house, and presented by him to the British Museum. The story of these nests is very remarkable, and shows how much we have to learn concerning the habits and instincts of insects.

In the month of August, 1862, a nest of the common WASP was taken near Brighthampton, and handed over to Mr. Stone, who has long been in the habit of experimenting upon these insects. One extraordinary nest which was built by wasps under his auspices, has already been mentioned on pages 90-92.

The nest was very much damaged by carriage, and Mr. Stone took it entirely to pieces, placing one or two small combs inside a square wooden box with a glass front, and supporting them by a wire which passed through the combs to the roof of the box. He then fixed the box in a window, so as to allow the insects free ingress and egress through a hole in the back.

About three hundred of the workers were then collected, placed in the box, and well supplied with sugar and beer. They immediately began to work, and their first object was to cover the combs with paper. They worked with great rapidity, and in two days had formed a flask-shaped nest, having covered both the combs and the wire, beside plastering large sheets of paper over

the sides of the box. They did not attempt to build upon the glass front, because it was frequently moved in order to introduce a supply of sugar. This nest is represented at fig. 4 on p. 223, and one of the wasps introduced, in order to show the comparative dimensions of the nest and its architects.

As the wasps were building at such a rate, it was evident that they would shortly fill the whole box with a shapeless mass of paper. Another similar box was therefore prepared, and the wasps ejected by



Mr Stone's Wasps' Nests No 1

tapping the box which was already completed. As soon as they were all out, the second box was substituted for the first, and the wasps crowded eagerly into it and again began their labours. In this box they were allowed to remain for a week, and the result was as is seen in fig. 3. The wasps were now transferred to a third box, in which they laboured for four days, and produced a nest somewhat similar to the others, but not quite so symmetrical.

At this time Mr. Stone fitted up another box

with two rows of wire pillars, eight in number, placed with tolerable regularity about two inches apart, and having a piece of comb at the base and summit of each. In this box the wasps remained for fifteen days, and in that time had covered all the wires and most of the combs, and had nearly filled the box with paper.

In order that a more symmetrical structure might be produced, a fifth box was fitted up with wires arranged in a different manner. Four wires were placed



Mr Stone's Wasps' Nests No 2

across the box, rather in advance of the middle, and two others in front of them. To all these wires a piece of comb was fixed at the base and summit, but between the two central pillars a short wire was placed, having a piece of comb at its summit only. The wasps were transferred to this box, and in the short space of five days, they covered all the combs and wires, and produced the extraordinary structure which is shown in fig. 1, and which looks like a paper imitation of a stalactitic cavern. The insects were

ejected from this nest before they had finished their work, and in consequence, a portion of the comb on the small central pillar is still left uncovered.

As this box had been so successful, another was prepared on the same principle, and the wasps were permitted to reside in it for the same number of days, in which time they produced an equally beautiful but rather more massive nest. This specimen is shown at fig. 2, on page 221. In hopes that the wasps might make a still more splendid nest, a



Mr. Stone's Wasps' Nests No 3

much larger box was fitted up, and the insects transferred to it. As by this time the autumn was closing in, and the weather became cold, the wasps could do but little work, and in a short time they died.

Thus, in the wonderfully short space of thirty-eight days, six elaborate and beautiful nests had been made by a single brood of wasps, and it is probable that if the original nest had been taken at an earlier period of the year, they would have made a still

larger number. However, such a feat as they did perform ought to make us look upon the wasp with a more indulgent eye, and although it cannot supply us with honey, as does the bee, it can certainly rival that useful insect in industry.

On looking at this beautiful series of nests, the observer cannot but admire the manner in which the instinct of these creatures is made subservient to human reason. Their instinct teaches them to cover all their combs with a thick mass of paper, the



Mr Stone's Wasps' Nests No 4

reason being, although they may not know it, that a certain uniformity of temperature is needed for the well-being of the eggs and young. If, therefore, combs are placed conveniently for the insects, they will assuredly cover them according to their instincts, and will as surely take advantage of wires or any other supports to which they can attach the fragile substance of which the nest is made.

Mr. Stone has made other experiments upon wasps,

and has kindly sent me the following account of his proceedings:—

"I have a beautiful series of their nests of this season's production (1864), from specimens which are the work of two or three hours, to those which have occupied as many months.

"But my working communities in a semi-domesticated state within the house, have for the last few weeks been going the wrong way. Earlier in the season, I had as many as ten colonies of various species at work in the different windows of the house which I have for some years used for the purpose, all of which went on satisfactorily for some time, but the sugar with which they were fed at length attracted a vast number of strangers, which crowded into the various boxes, and at first impeded, and ultimately put an end to the work. Before this event happened, one extraordinary nest had become advanced as far as I wished; and a second, which was still more extraordinary, almost as far as I desired. The facts connected with these nests are as follows:—

"I had a working community of *Vespa germanica* in the left-hand corner of a window on the ground-floor, and another in the right-hand corner. When these nests had increased in size to four or five inches in diameter, I chloroformed the insects, removed the shell or covering of each nest from the combs, putting aside the coverings for specimens. In order to remove the combs, I had to cut out a piece from the outside, and when this was neatly united again, the empty shells had all the appearance of perfect nests, with this advantage, that they contained nothing which required drying in an oven in order to prevent decomposition, which must have been done had the combs, with their complement of grubs, &c., been allowed to remain in the nests. This plan I always adopt when it is practicable. I then returned the combs to the boxes from which

they were respectively taken, and introduced the workers, still in a comatose state from the effects of the chloroform. As soon as they recovered from their stupor, they set to work at constructing fresh coverings.

"I now brought home a nest of *Vespa vulgaris*, with its inmates. This was placed for work in a box in the left-hand corner of a room immediately over the one just mentioned. Soon after this, I perceived that the newly-formed covering to the nest of the *V. germanica* in the left-hand corner of the window below was beginning to assume a variety of curious colouring. On clipping away the covering, when it became sufficiently advanced for another specimen, I found that numbers of workers from the nest of *V. vulgaris*, situated in the window above, had actually joined themselves to this nest, and had been working with its original inmates.

"Not only had they been working in concert with them, but they had been depositing eggs in the cells, as is proved by the fact that numbers of young specimens of *V. vulgaris* were afterwards bred from the combs contained in the nest of *V. germanica*. I do not know whether you are aware that worker wasps have the power of producing fertile eggs without contact with the other sex; yet such I have proved over and over again to be the case.

"Well, having again, as above stated, removed the covering from this nest, I took away the lower comb and reduced the nest somewhat in size, placing them in a box thirteen inches in length, and arranged in such a way that the workers should necessarily produce a vase, or rather a goblet-shaped nest. This they did, and a splendid object it is, being, as before, the joint work of two species of wasps, the one, *V. vulgaris*, using, as it invariably does, decayed wood (such as is commonly called touchwood), and the other, *V. germanica*, using sound wood, or sound vegetable fibre of some kind, in the fabrication of its paper.

Thus they gave to the coverings of both these nests an extraordinary beauty, from the variety and charming distribution of the colours with which they were enriched.

"As none of the workers from the nest of *V. vulgaris* were ever found to attach themselves to the nest of *V. germanica*, which was situated in a similar corner of the window below, I conclude that they made no mistake as to the corner of the window in which their nest was situated, but miscalculated the height of the window. As they entered the strange nest with food and building material, they were not molested, but allowed to join peaceably in the work of the nest.

"Widely different would have been the case had they entered it for the purpose of pillage; for, though wasps will not interfere with strange individuals of their own species, even when they come with thievish intentions, they instantly seize all individuals of a different species, if their intentions appear suspicious.

"I have since met with another instance of the kind.

"Two nests were situated almost close together in a drain at Cokethorpe Park, one belonging to *V. vulgaris*, and the other having been originally the property of *V. germanica*. It would, however, appear that at an early period in the season, workers from the former nest had attached themselves to the latter, their numbers increasing as the season advanced. Judging from the appearance of the nest, and from the amount of work done by each species, it was easy to see that at the end of August, when I dug it out, the number of individuals of each species was almost equal. There is no possibility of mistaking the work of one species for that of the other, and the distinction is apparent at a glance.

"Apart from the interest attached to nests of this description, no examples of which had been, as far as

I am aware, obtained by any naturalist, their beauty of colouring is so remarkable as to render them objects of general admiration. If, too, as I apprehend must have been the case, the workers belonging to the colony of *V. vulgaris* mistook their neighbours' house for their own, the entrances being so near together, it is rather extraordinary that those belonging to the other species should not have made a similar mistake. They appeared, however, not to have done so, or if they did, the mistake must have been rectified as often as it occurred, for no work of theirs was to be found in the nest of *V. vulgaris*."

Before closing the history of the wasps, I may mention that the two species, *Vespa germanica* and *Vespa vulgaris*, are so similar to each other in shape and colour, that an unpractised eye cannot readily discern the distinction between them. Specimens of both these wasps are now before me, and when placed side by side the difference is clearly evident. The yellow colour predominates in the former insect, and the dark bands of the abdomen are much narrower. In the female *Vespa germanica*, there are three black spots on the basal margin of the first segment of the abdomen.

In Mr. Bates's valuable work on the Natural History of the Amazons, there is an interesting account of the proceedings of certain ants belonging to the genus *Eciton*, and which are popularly classed together under the name of FORAGING ANTS. These insects have often been confounded with the Sauba or Parasol Ant, which has already been described, although they belong to different groups and have different habits. The native name for them is Tauóca. There are many species belonging to this genus, and I shall therefore restrict myself to those which seem to have the most interesting habits, giving at the same time a general sketch of their character. I regret that, as in so many other cases, the lack of

popular names forces me to employ the scientific titles by which the insects are known to naturalists.

Although in the Ecitons there are the three classes of males, females, and neuters, these neuters are not divided into two distinct sets as in the termites, but are found in regular gradations of size. The real Foraging Ant is *Eciton drepanophora*, and it is this insect which is so annoying and so useful to house-builders. The ants sally forth in vast columns, at least a hundred yards in length, though not of very great width. On the outside of the column are the officers, which are continually running backwards and forwards, as if to see that their own portions of the column are proceeding rightly. The proportion of officers to workers is about five per cent., or one officer to twenty workers, and they are extremely conspicuous on the march, their great white heads nodding up and down as they run along.

One of the large workers is now before me, and a most formidable insect it looks. Its head is round, smooth, and very large, and is armed with a pair of enormous forceps, curved almost as sharply as the horns of the chamois, and very sharp at the points. Their length is so great, that if straightened and placed end to end, they would be longer than the head and body together. They are beset with minute hairs, which, when viewed under the microscope, are seen to be stiff bristles, arranged in regular rings round the mandibles. The thorax and abdomen are but slender, and the limbs are long, giving evidence of great activity. In the dried specimen, the colour of the insect is yellowish-brown, becoming paler on the head, but when the creature is alive, the head is nearly white. The eyes are very minute, looking like little round dots on the side of the head, and being so extremely small that they can scarcely be perceived without the aid of a magnifying-glass. The half-inch power of the microscope shows

that they are oval and convex, but as they are set in little pits or depressions, they do not project beyond the head. The hexagonal compound lenses, which are generally found in insects, are not visible, and the eye bears a great resemblance to that of the spider.

The difference in dimensions of the workers is very



FORAGING ANTS.

remarkable. The specimen which I have just described measures a little under half an inch in length, exclusive of the limbs, while another specimen is barely half that length, and in general appearance much resembles the familiar ant, or emmet of our gardens.

The presence of these insects may be always known by the numbers of pittas, or ant-thrushes which feed

much upon them, and which are sure to accompany a column of Foraging Ants on the march. The ant-thrushes are odd, short-tailed birds, with stout bodies, and a remarkably long hind claw. Some of this species are decorated with colours of wonderful brilliancy, glittering with blue, green, copper-red, and purple, and having a peculiar silken gloss. Others are soberly clad in simple brown and white, and such are the birds which usually accompany the Foraging Ants on their march.

As soon as the experienced inhabitants of tropical America see the ant-thrushes, they rejoice in the coming deliverance, and welcome the approaching army. The fact is, that in those countries insect life swarms as luxuriously as the vegetation, and there are many insects which, however useful in their own place, are apt to get into houses, and there multiply to such an extent that they become a real plague, and nearly drive the inhabitants out of their own homes. They are bad enough by day, but at night they issue from the nooks and crevices where they lay concealed, and make their presence too painfully known.

There are insects that bite, and insects that suck, and insects that scratch, and insects that sting, and many are remarkable for giving out a most horrible odour. Some of them are cased in armour as hard as crab-shells, and will endure almost any amount of violence, while some are as round, as plump, as thin-skinned, and as juicy as over-ripe gooseberries, and collapse almost with a touch. There are great flying insects which always make for the light, and unless it is defended by glass, will either put it out, or will singe their wings and spin about on the table in a manner that is by no means agreeable. The smaller insects get into the ink-stand and fill it with their tiny carcasses, while others run over the paper and smear every letter as it is made.

There are great centipedes, which are legitimate cause of dread, being armed with poison fangs scarcely less venomous than those of the viper. There are always plenty of scorpions; while the chief army is composed of cockroaches, of dimensions, appetite, and odour such as we can hardly conceive in this favoured land. As to the lizards, snakes, and other reptiles, they are so common as almost to escape attention.

For a time these usurpers reign supreme. Now and then a few dozen are destroyed in a raid, or a person of sanguine temperament amuses his leisure hours, and improves his marksmanship, by picking off the more prominent intruders with a saloon pistol; but the vacancies are soon filled up, and no permanent benefit is obtained. But when the Foraging Ants make their appearance, the case is altered, for there is nothing that withstands their assault. As soon as the pittas are seen approaching, the inhabitants throw open every box and drawer in the house, so as to allow the ants access into every crevice, and then retire from the premises.

Presently the vanguard of the column approaches, a few scouts precede the general body, and seem to inspect the premises, and ascertain whether they are worth a search. The long column then pours in, and is soon dispersed over the house. The scene that then ensues is described as most singular. The ants penetrate into the corners, peer into each crevice, and speedily haul out any unfortunate creature that is lurking therein. Great cockroaches are dragged unwillingly away, being pulled in front by four or five ants, and pushed from behind by as many more. The rats and mice speedily succumb to the onslaught of their myriad foes, the snakes and lizards fare no better, and even the formidable weapons of the scorpion and centipede are overcome by their pertinacious foes.

In a wonderfully short time, the Foraging Ants have completed their work, the scene of turmoil gradually

ceases, the scattered parties again form into line, and the procession moves out of the house, carrying its spoils in triumph. The raid is most complete, and when the inhabitants return to the house, they find every intruder gone, and to their great comfort are enabled to move about without treading on some unpleasant creature, and to put on their shoes without previously knocking them against the floor for the purpose of shaking out the scorpions and similar visitors.

In the illustration a column of Foraging Ants is seen winding its way through a wood. Every one who is accustomed to the country takes particular care not to cross one of these columns. The Foraging Ants are tetchy creatures, and not having the least notion of fear, are terrible enemies even to human beings. If a man should happen to cross a column, the ants immediately dash at him, running up his legs, biting fiercely with their powerful jaws, and injecting poison into the wound. The only plan of action in such a case is, to run away at top speed until the main body are too far off to renew the attack, and then to destroy the ants that are already in action. This is no easy task, for the fierce little insects drive their hooked mandibles so deeply into the flesh that they are generally removed piecemeal, the head retaining its hold after the body has been pulled away, and the mandibles clasped so tightly that they must be pinched from the head and detached separately.

There seems to be scarcely a creature which these insects will not attack, and they will even go out of their way to fall upon the nests of the large and formidable wasps of that country. For the thousand stings the ants care not a jot, but tear away the substance of their nest with their powerful jaws, penetrate into the interior, break down the cells, and drag out the helpless young. Should they meet an adult wasp, they fall upon it, and cut it to pieces in a moment.

Another species, *Eciton prædator*, does not form long and narrow columns, but marches in a broad and solid phalanx. It is but a little creature, no bigger than the common red ant of England. It is, however, of a brighter red colour, and when a phalanx of these ants ascends a tree, the vast multitudes spread over all the trunk and branches in such numbers, that the tree looks as if a blood-red liquid was being poured over it.

There is another Foraging Ant which forms in broad columns when on the march. This is *Eciton legionis*, a species which is not so common as either of the preceding, and appears only to be seen on the wide sand plains of Santarem.

These insects sometimes attack the nest of one of the large burrowing ants. Mr. Bates mentions that on one occasion, he watched a large army of Foragers begin their attack upon the nest of an ant, some specimens of which he desired to procure. The Foragers set to work with wonderful skill, arranging themselves into two distinct sets of labourers, one set digging into the ground and taking out large pellets of earth, and the other set receiving them from their comrades and carrying them away.

While watching the proceedings of the soldiers when repairing the Thames river-wall after the terrible explosion near Belvedere, I was strongly reminded of the Foraging Ants and their method of working. The parallel was exact in every respect. The officers stood here and there and directed the efforts of their men, while the workers were arranged in regular lines, one set of men digging out the clods of earth, and a second set receiving them and handing them to the spot where they were wanted. I could but fancy that if an observer had been poised at some height above the beach in a balloon, watching the soldiers at work, and had previously seen an army of Ecitons engaged in sinking a shaft, he would have seen the insects and their

labours precisely reproduced in the human beings, art having at last discovered a process which was in full operation before man knew how to handle a weapon or a tool.

After Mr. Bates had watched the proceedings of the ants for some time, he took a trowel, and opened the ground with it. The clever insects at once took advantage of this aid, and dashed into the breach by thousands, pouncing on the luckless inhabitants and carrying them off in their jaws. So bold and so quick were they, that Mr. Bates could scarcely manage to secure a single specimen, and even when he had caught an ant, the Foragers would pull it out of his fingers.

The same observer has known them to sink their shafts to a depth of ten inches, invariably succeeding in their raid upon the nest. The materials of which the nest is made they pull to pieces, and carry the fragments home, together with the inmates. When the nest is completely sacked, the invaders move out in small lines, which march to join the main body, and soon unite with it. The discipline of the community is really wonderful. Each insect knows its own place and its own work, and so perfect is the organisation, that during the busy season the long train resolves itself into two distinct columns, one going out to search for food, and the other returning home laden with spoil.

The last species of Eciton which I shall mention, is that wonderful species which is called the BLIND ANT (*Eciton erratica*).

I have already mentioned that in Eciton drepanophora the eyes are very small, but in the Blind Ant they are absolutely wanting, the horny covering of the head being quite uniform, without the least trace of external eyes. Some naturalists have thought that the Blind Ant may possess organs of vision, and that the horny covering of the head is sufficiently transparent to

admit the light. That the insects can distinguish light from darkness is perfectly true, for they display the greatest uneasiness when brought into the light, and therefore it is possible that the optic nerves may be in some degree affected, though there are no external organs of vision. But the covering of the head is certainly too thick and too opaque to permit distinct vision, and that the insect can see an object clearly is manifestly impossible.

These insects are wonderful builders, and bear a great resemblance to the termites in many of their proceedings. The reader will remember that the termites always choose to work under cover, and proceed from one place to another by means of galleries, which they construct with great rapidity. The Blind Ant acts in a precisely similar manner, constructing long galleries through which it travels. These galleries are of small dimensions, though their length is almost unlimited, and they are made in a very flimsy manner, without the use of any cement. If the observer wishes to capture some of the large-headed officers, he can easily do so by breaking down any part of the gallery. As soon as the unwelcome light streams in, the soldiers are seen to come slowly out, moving their great heads from side to side, and opening their powerful jaws with silent menace. If they are not further disturbed, they will retire into the gallery, and the breach is soon mended by the workers.

These galleries cannot be called tunnels, because they are built upon the surface of the earth, and do not penetrate below it, and ought perhaps to be called "covered ways," rather than galleries.

I have intentionally reserved the last place among the builders for an insect which is certainly the most wonderful of them all; not only raising an edifice, but clearing a space around, and preparing it for a garden.

This insect is called by Dr. Lincecum, the discoverer of its habits, the AGRICULTURAL ANT. As the reader will perceive, it is allied to the Parasol Ant, which has been already described.

This remarkable insect is a native of Texas, and until a few years ago its singular habits were unknown. Dr. Lincecum, however, wrote a long and detailed account to Mr. Darwin, who made an abstract of it, and read the paper before the Linnean Society, April 18, 1861. This abstract may be found in the Journal of that Society, and is as follows:—

“The species which I have named ‘Agricultural’ is a large, brownish ant. It dwells in what may be termed paved cities, and like a thrifty, diligent, provident farmer, makes suitable and timely arrangements for the changing seasons. It is, in short, endowed with skill, ingenuity, and untiring patience, sufficient to enable it successfully to contend with the varying exigencies which it may have to encounter in the life-conflict.

“When it has selected a situation for its habitation, if on ordinary dry ground, it bores a hole, around which it raises the surface three and sometimes six inches, forming a low circular mound, having a very gentle inclination from the centre to the outer border, which on an average is three or four feet from the entrance. But if the location is chosen on low, flat, wet land, liable to inundation, though the ground may be perfectly dry at the time the ant sets to work, it nevertheless elevates the mound, in the form of a pretty sharp cone, to the height of fifteen to twenty inches or more, and makes the entrance near the summit. Around the mound, in either case, the ant clears the ground of all obstructions, and levels and smooths the surface to the distance of three or four feet from the gate of the city, giving the space the appearance of a handsome pavement, as it really is.

“Within this paved area, not a blade of any green

thing is allowed to grow, except a single species of grain-bearing grass. Having planted this crop in a circle around, and two or three feet from the centre of the mound, the insect tends and cultivates it with constant care, cutting away all other grasses and weeds that may spring up amongst it, and all around outside the farm-circle to the extent of one or two feet more. The cultivated grass grows luxuriantly, and produces a heavy crop of small, white, flinty seeds, which under the microscope very closely resemble ordinary rice. When ripe, it is carefully harvested and carried by the workers, chaff and all, into the granary cells, where it is divested of the chaff and packed away. The chaff is taken out and thrown beyond the limits of the paved area.

"During protracted wet weather, it sometimes happens that the provision-stores become damp, and are liable to sprout and spoil. In this case, on the first fine day, the ants bring out the damp and damaged grain, and expose it to the sun till it is dry, when they carry it back and pack away all the sound seeds, leaving those that had sprouted to waste.

"In a peach orchard not far from my house is a considerable elevation, on which is an extensive bed of rock. In the sand-beds overlying portions of this rock are fine cities of the Agricultural Ants, evidently very ancient. My observations on their manners and customs have been limited to the last twelve years, during which time the enclosure surrounding the orchard has prevented the approach of cattle to the ant-farms. The cities which are outside the enclosure, as well as those protected in it, are at the proper season invariably planted with the ant-rice. The crop may accordingly always be seen springing up within the circle about the 1st of November every year. Of late years, however, since the number of farms and cattle has greatly increased, and the latter are eating off the grass much closer than

formerly, thus preventing the ripening of the seeds, I notice that the Agricultural Ant is placing its cities along the turn-rows in the fields, walks in gardens, inside about the gates, &c., where they can cultivate their farms without molestation from the cattle.

"There can be no doubt that the particular species of grain-bearing grass mentioned above is intentionally planted. In farmer-like manner the ground upon which it stands is carefully divested of all other grasses and weeds during the time it is growing. When it is ripe, the grain is taken care of, the dry stubble cut away and carried off, the paved area being left unencumbered until the ensuing autumn, when the same 'ant-rice' reappears within the same circle, and receives the same agricultural attention as was bestowed upon the previous crop—and so on, year after year, as I know to be the case, in all situations where the Ants' settlements are protected from graminivorous animals."

After receiving this account, Mr. Darwin wrote to Dr. Lincecum, asking him whether he thought that the Ants planted seed for the next year's crop, and received the following answer: "I have not the slightest doubt of it. And my conclusions have not been arrived at from hasty or careless observation, nor from seeing the Ants do something that looked a little like it, and then guessing the results. I have at all times watched the same ant-cities during the last twelve years, and I know that what I stated in my former letter is true. I visited the same cities yesterday, and found the crop of ant-rice growing finely, and exhibiting also the signs of high cultivation, and not a blade of any other kind of grass or seed was to be seen within twelve inches of the circular row of ant-rice."

## CHAPTER X.

*SUB-AQUATIC NESTS—VERTEBRATES*

Fishes as architects—The STICKLEBACKS and their general habits—The FRESH-WATER STICKLEBACKS—A jealous proprietor—Punishment of trespassers—Form and materials of the nest—Use of the nest—Cannibalistic propensities—The FIFTEEN-SPINED STICKLEBACK and its form—Its curious nest—Mr Couch's description of a nest in a rope's end—Fishes of Guiana—The HASSAR or HARDBACK and its place in zoology—Nest of the Hassar—Parental watchfulness—singular position of the nest—Habits of the Hassar

As a rule, FISHES display but little architectural genius, their anatomical construction debarring them from raising any but the simplest edifice. A fish has but one tool, its mouth, and even this instrument is of very limited capacity. Still, although the nest which a fish can make is necessarily of a slight and rude character, there are some members of that class which construct homes which deserve the name.

The best instances of architecture among the fishes are those which are produced by the STICKLEBACKS, those well-known little beings whose spiny bodies, brilliant colours, and dashing courage make them such favourites with all who study nature. There are several species of British Sticklebacks, but as the fresh-water species all make their nests in a very similar manner, there will be no need of describing each species separately.

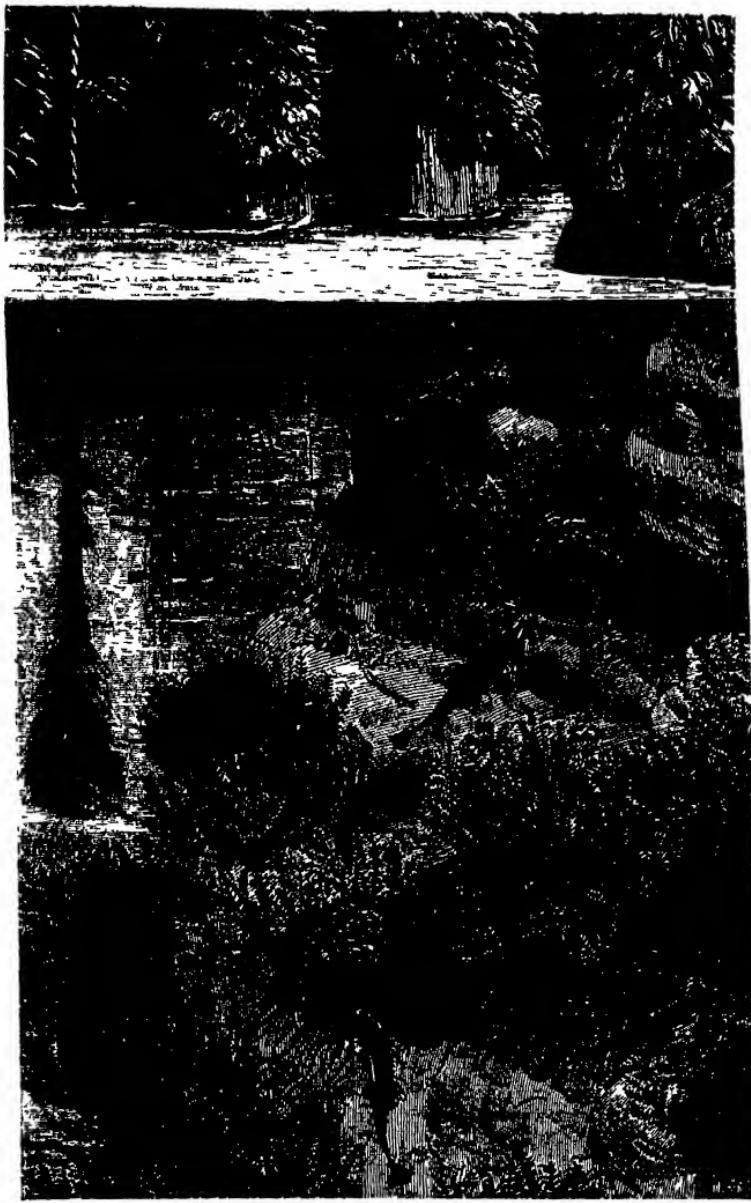
These fishes make their nests of the delicate vegetation

that is found in fresh water, and will carry materials from some little distance in order to complete the home. They do not, however, range to any great extent, because they would intrude upon the preserve of some other fish, and be ruthlessly driven away.

When the male Stickleback has fixed upon a spot for his nest, he seems to consider a certain area around as his own especial property, and will not suffer any other fish to intrude within its limits. His boldness is astonishing, for he will dash at a fish of ten times his size, and, by dint of his fierce onset and his bristling spears, drive the enemy away. Even if a stick be placed within the sacred circle, he will dart at it, repeating the assault as often as the stick may trespass upon his domains. Within this limit, therefore, he must seek materials for his nest, as he can hardly move for six inches beyond it without intruding upon the grounds of another fish. This right of possession only seems to extend along the banks and a few inches outwards, the centre of the stream or ditch being common property. Along the bank, however, where vegetation is most luxuriant, there is scarcely a foot of space that is not occupied by some Stickleback, and jealously guarded by him.

Although the nests of the Stickleback are plentiful enough, they are not so familiar to the public as might be expected, principally because they are very inconspicuous, and few of the uninitiated would know what they were, even if they were pointed out. Being of such very delicate materials, and but loosely hung together, they will not retain their form when they are removed from the water, but fall together in an undistinguishable mass, like a coil of tangled thread that had been soaked in water for a few weeks.

The materials of which the nest is made are extremely variable, but they are always constructed so as to harmonise with the surrounding objects, and thus to



FIFTEEN-SPINED STICKLEBACKS AND NESTS

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escape ordinary observation. Sometimes it is made of bits of grass which have been blown into the river, sometimes of straws, and sometimes of growing plants. The object of the nest is evident enough, when the habits of the Stickleback are considered. As is the case with many other fish, there are no more determined destroyers of Stickleback eggs than the Sticklebacks themselves, and the nests are evidently constructed for the purpose of affording a resting-place for the eggs until they are hatched. If a few of these nests be removed from the water in a net, and the eggs thrown into the stream, the Sticklebacks rush at them from all sides, and fight for them like boys scrambling for halfpence. The eggs are very small, barely the size of dust-shot, and are yellow when first placed in the nest, but deepen in colour as they approach maturity.

There is a well-known marine species of this group, called the FIFTEEN-SPINED STICKLEBACK, a long-bodied, long-snouted fish, with a slightly projecting lower jaw, and a row of fifteen short and sharp spines along the back. This creature makes its nest of the smaller algae, such as the corallines, and the delicate green and purple seaweeds which fringe our coasts.

Sometimes, indeed, it becomes rather eccentric in its architecture, and builds in very curious situations. Mr. Couch, the well-known ichthyologist, mentions a case where a pair of Sticklebacks had made their nest "in the loose end of a rope, from which the separated strands hung out about a yard from the surface, over a depth of four or five fathoms, and to which the materials could only have been brought, of course in the mouth of the fish, from the distance of about thirty feet. They were formed of the usual aggregation of the finer sorts of green and red seaweed, but they were so matted together in the hollow formed by the untwisted strands of the rope, that the mass constituted an oblong ball of nearly the size of the fist, in which had been deposited the

scattered assemblage of spawn, and which was bound into shape with a thread of animal substance, which was passed through and through in various directions, while the rope itself formed an outside covering to the whole."

This is not the only fish that is known to construct a nest.

In the fresh waters of tropical America there is a genus of fish belonging to the Siluridæ, and named *Callichthys*, from the beauty of the species. The fishes of this genus have four very long barbules hanging from the upper lip and pointing backwards, and are all mailed except part of the belly. Their general colour is green-brown, and they do not reach to any great size, eight inches being their usual length. They are generally very fat, and are much valued by the natives of Guiana, who live so much upon fish. The native name for this fish is HASSAR, and the European residents call it the HARDBACK, in allusion to its coat of shining mail.

To the naturalist, however, the chief point of interest in these fish is the fact that they are in the habit of constructing nests which are quite as well formed as those of the stickleback, and are made of grass-blades, straws, and leaves. These nests are very plentiful in the little muddy streamlets that intersect the sugar marshes, so that the habits of the fish can be easily watched. The parent fish is very jealous of the eggs, and waits near them until they are hatched, and the young family committed to the water. The natives are well aware of this habit, and catch the fish readily by insinuating a net or even a basket under the water near a nest, and then raising it quickly, when the parent fish is mostly found in the net.

Perhaps the most curious part of the economy of this fish is the fact that the nest is not placed *in* the water,

but in a muddy hole just above the surface. This habit, however, accords with the qualities of the fish, which is remarkably independent of water, and can travel over land from one pond to another, led by some mysterious instinct, which we of higher powers cannot comprehend. During the dry season the Hassar is in the habit of burrowing into the mud, and there residing until the welcome rain sets it free. Those who know the customs of the fish are therefore able to procure it at almost any period of the year, digging for it in the dry season, and fishing for it in the wet months.

## CHAPTER XI.

*INVERTEBRATES.*

A pool and its wonders—The WATER SPIDER—Its sub-aquatic nest—Conveyance of air to the nest—The diving-bell anticipated—Character of the air in the nest—Mr Bell's experiments upon the Spider—Life of the Water Spider—The HYDRACHNA—The CADDIS FLIES and their characteristics—Sub-aquatic homes of the larva—Singular varieties of form and material—Life of a Caddis—Description of nests in my own collection—Fixed cases, and modification of larva—Singular materials for nest-building

WHEN I was a very little boy, I was accustomed to spend much time on the banks of the Cherwell, and used to amuse myself by watching the various inhabitants of the water. Animal life is very abundant in that pleasant little river, and there was one favourite nook where a branch of a weeping-willow projected horizontally, and afforded a seat over the dark deep pool, one side of which was abrupt and the other sloping.

Here the merry gyrini ran their ceaseless rounds, and the water-boatmen rowed themselves in fitful jerks, or lay resting in a contemplative manner on their oars. Now and then an unlucky insect would fall from the tree into the water, and then uprose from the dark depth a pair of dull eyes and a gaping mouth, and then with a glitter as of polished silver, the dace would disappear with its prey. In the shelving part of the pool the caddis-worms moved slowly along, while the great

dyticus beetle would rise at intervals to the surface, jerk the end of his tail into the air, and then dive below to the muddy bottom. This spot was much favoured by the nursemaid, for she had no trouble in watching me, as long as I could sit on the branch and look into the water. True, I might have fallen into the river, but I never did; and even had that accident occurred, it would have wrought no harm, except wet clothes, for I could swim nearly as well as the water-insects themselves.

Close under the bank lived some creatures which always interested me greatly. Spiders they certainly were, but they appeared to have the habits of the water-beetle—coming slowly to the surface of the water, giving a kind of flirt in the air, and then disappearing into the depths, looking like balls of shining silver as they sank down. I had been familiar with these creatures for years before I met with them in some book, and learned that they were known under the name of WATER SPIDER.

This Spider is a most curious and interesting creature, because it affords an example of an animal which breathes atmospheric air, constructing a home beneath the water, and filling it with the air needful for respiration.

The sub-aquatic cell of the Water Spider may be found in many rivers and ditches, where the water does not run very swiftly. It is made of silk, as is the case with all spiders' nests, and is generally egg-shaped, having an opening below. This cell is filled with air; and if the Spider be kept in a glass vessel, it may be seen reposing in the cell, with its head downwards, after the manner of its tribe. The precise analogy between this nest and the diving-bell of the present day is too obvious to need a detailed account. How the air is introduced into the cell is a problem that was for some time unsolved. The reader is probably aware that the bubbles of air which are to be seen on sub-aquatic plants are almost entirely

composed of oxygen gas, which is exuded from the plant, and which is so important an agent in purifying the water.



WATER SPIDER

Some zoologists thought that the air which is found in the cell of the Water Spider was nothing but oxygen

that had been exuded from the plant upon which the nest was fixed, and that it had been intercepted in its passage to the surface. In order to set the question at rest, Mr. Bell, the well-known naturalist, instituted a series of experiments upon the Spider, and communicated the results to the Linnean Society. The experiments were made in 1856, and Mr. Bell's remarks are as follows:—

“No. 1. Placed in an upright cylindrical vessel of water, in which was a rootless plant of *Stratiotes*, on the afternoon of November 14. By the morning it had constructed a very perfect oval cell, filled with air, about the size of an acorn. In this it has remained stationary up to the present time.

“No. 2. Nov. 15. In another vessel, also furnished with *Stratiotes*, I placed six *Argyronetrae*. The one now referred to began to weave its beautiful web about five o'clock in the afternoon. After much preliminary preparation, it ascended to the surface, and obtained a bubble of air, with which it immediately and quickly descended, and the bubble was disengaged from the body, and left in connection with the web. As the nest was, on one side, in contact with the glass, enclosed in an angle formed by two leaves of the *Stratiotes*, I could easily observe all its movements. Presently it ascended again and brought down another bubble, which was similarly deposited.

“In this way, no less than fourteen journeys were performed, sometimes two or three very quickly one after another; at other times with a considerable interval between them, during which time the little animal was employed in extending and giving shape to the beautiful transparent bell, getting into it, pushing it out at one place, and amending it at another, and strengthening its attachments to the supports. At length it seemed to be satisfied with its dimensions, when it crept into it and settled itself to rest with the head downwards.

The cell was now the size and nearly the form of half an acorn cut transversely, the smaller and rounded part being uppermost.

"No. 3. The only difference between the movements of this and the former was, that it was rather quicker in forming its cell. In neither vessel was there a single bubble of oxygen evolved by the plant.

"The manner in which the animal possesses itself of the bubble of air is very curious, and as far as I know, has never been exactly described. It ascends to the surface slowly, assisted by a thread attached to the leaf or other support below and to the surface of the water. As soon as it comes near the surface, it turns with the extremity of the abdomen upwards, and exposes a portion of the body to the air for an instant, then with a jerk it snatches, as it were, a bubble of air, which is not only attached to the hairs which cover the abdomen, but is held on by the two hinder legs, which are crossed at an acute angle near their extremity, this crossing of the legs taking place at the instant the bubble is seized. The little creature then descends more rapidly and regains its cell, always by the same route, turns the abdomen within it, and disengages the bubble.

"No. 4. Several of them, when I received them, had the hair on the abdomen wetted, and I placed them on some blotting-paper until they were dry. On returning them to the water, two remained underneath a floating piece of cork, and the hair being now dry, retained the pellicle of air which is ordinarily observed. One of the two came out of the water, attached the cork to the glass, and wove a web against the latter, against which it rested about a quarter of an inch above the surface of the water. After remaining there about two days, it resumed its aquatic habits, and, like all others, formed its winter habitation."

Water Spiders are now familiar to us on account of

the widespread fashion for aquaria, but so thoroughly have the ditches and streams been ransacked by professional dealers, that the creature has become quite rare in spots where it was once plentiful.

The Water Spider places her eggs in this cell, spinning a saucer-shaped cocoon, and fixing it against the inner side of the cell and near the top. In this cocoon are about a hundred eggs, of a spherical shape, and very small. The cell is a true home for the spider, which passes its earliest days under the water, and when it is strong enough to construct a sub-aquatic home for itself, brings its prey to the cell before eating it.

The colour of the Water Spider is brown, with a greyish surface caused by the thick growth of hair which covers the body, and with a very slight tinge of red on the cephalothorax. The reader must not confound this creature with another Arachnid that is sometimes called the Water Spider (*Hydrachna cruenta*), and is of a bright scarlet colour, with a peculiar velvety surface.

There is an order of insects which is especially dear to anglers; not so much to fly-fishers, as to those who like to sit and look at a float for several consecutive hours. This order is scientifically termed TRICHOPTERA, or Hair-winged insects, and the various species of which it is composed are classed together under the familiar title of CADDIS FLIES.

These insects may always be known by the peculiar leathery aspect of the body, and by the coating of hair with which the wings are covered, the long hairs being spread over the whole surface, and standing boldly out like a fringe round the edge. They all have long and slender antennæ, and in some genera, such as *Mystacida*, these organs are nearly three times as long as the head and body, reminding the observer of the lovely Japan moths (*Adelæ*) whose delicate antennæ wave and glitter

in the sunbeams like stray threads of spiders' web.  
For the perfect insect the angler cares comparatively



little. Imitations in hair, feather, and silk are useful to the fly-fisher, and are known to anglers by the eccentric nomenclature by which such imitations are

called. It is the larva in which the angler delights, and it is chiefly of the larva that our present description will treat.

We will now trace the life of the Caddis Fly from the egg to the perfect insect.

In the breeding season, the female may be observed to carry about with her a double bundle of little greenish eggs, probably in order to expose them for a certain time to the warm sunbeams before they are immersed in the water. This curious bundle is a long oval in shape, and is bent sharply in the middle, its extremities being attached to the abdomen of the insect. When her instinct tells her of the proper time, she proceeds to the water, and attaches the eggs to the leaf of some aquatic plant, often crawling down the stem for several inches. The Caddis Fly is quite at home on the water, and, unlike the dragon flies, which are quite helpless when immersed, can run on the surface with considerable speed, and on occasion can swim below the surface with scarcely less rapidity.

They may often be observed in the act of running on the water, and while they are thus employed, they often fall victims to some hungry fish, which is attracted by the circling ripples occasioned by the movement of the limbs. Fly-fishers, who are acquainted with the habits of fishes and insects, take advantage of their knowledge, and by causing their imitation Caddis Fly to ripple over the surface, or even to sink beneath it, like the veritable insect, delude the unsuspecting fish into swallowing a hook instead of a fly.

In process of time the eggs are hatched, and the young larvæ then proceed to construct houses in which they can dwell. These houses are formed of various materials and are of various shapes, and, indeed, not only does each species have its own particular form of house, but there is considerable variety even in the houses of a single species. In the accompanying illustration are shown a

number of the nests formed by the Caddis Fly in its larval state, together with the perfect insects. All the figures have been drawn from actual specimens, some of which are in the British Museum, and others in my own collection. The materials of which the nest is made depend greatly on the locality in which the insect is hatched, and in a rather large series of Caddis nests now before me, there are some very remarkable instances of the manner in which the insect has been obliged to adapt itself to circumstances. The most common style of case is that which is composed of a number of sticks and grass stems laid longitudinally upon each other like the fasces of the Roman consuls. Of these I have specimens of various sizes and shapes, some being barely half an inch long, while others measure four times that length, the sticks being sometimes placed so irregularly that the home of the architect is not easily seen. The creatures are not at all particular about the straightness of the sticks, but take them of any degrees of curvature, as in one of the examples represented in the illustration, where the stick is not only curved, but has a large bud at the end.

Another case is made of the hollow stem of some plant, apparently that of a hemlock, to which are attached a few slips of bark from the plants. Next comes a series of cases in which the Caddis larva has contrived to secure a great number of cylindrical grass stems and arranged them transversely in several sets, making one set cross the other, so as to leave a central space in which the little architect can live. One or two cases are made wholly of bark, apparently the cuticle of the common reed, a plant which is very common in the Cherwell, whence the cases were taken. In all probability these strips of cuticle have been dropped into the river by the water rats while feeding on the reeds.

Several cases are made entirely of leaves, mostly taken from the white-thorn, which grows in great quantities

along the banks of the above-mentioned river. Then there are cases which are equally composed of sticks and leaves, these materials generally occupying opposite ends of the case. There is another series of cases made up of fine grass, apparently the *débris* of hay which had been blown into the water during the summer, and having the materials laid across each other like the needles of a stocking-knitter. Most of these cases are balanced by a stone.

Next come a number of cases which are composed of small shells, those of the Planorbis being the most common, and having among them a few specimens of the Limnaea, or pond-snail, and many separate valves and perfect shells of the fresh-water mussel. The Caddis larva is an incorrigible kidnapper, seizing on any shell that may suit its purpose, without troubling itself about the inhabitant. It is quite a common occurrence to find four or five living specimens of the Planorbis and Limnaea affixed to the case of a Caddis larva, and to see the inhabitants adhering to the plants and endeavouring to proceed in one direction while the Caddis is trying to walk in another, thus recalling the well-known episode of the Tartar and his captor. In these cases the cylindrical body is made of sand and small fragments of shells bound together with a waterproof cement, and the shells are attached by their flat sides to the exterior.

There are also several cases which are made entirely of sand cemented together, some being cylindrical and others tapering to a point, like an elephant's tusk. There are also examples of mixed structures, where the Caddis has combined shells with the leaf and twig cases, and in one of these instances, the little architect has bent back the valves of a small mussel, and fastened them back to back on its house. Beside these, there are one or two very eccentric forms, where the Caddis has chosen some objects which are not often seen in such a position.

The seed-vessels of the elm are tolerably common, but I have several specimens where the Caddis has taken the operculum of a dead pond-snail and fastened it to the case; and there is an example where the chrysalis of some moth, apparently belonging to the genus *Porthesia*, has been blown into the water from a tree overhanging the stream, and seized upon by a Caddis as an unique ornament for its house. These latter examples were found in a stream in Wiltshire, and the tusk-like sand-cases were found in a disused stone quarry in the same county.

Various experiments have been tried upon the larva of the Caddis, in order to see its mode of building. A lady, Miss Smee, has been very successful in this pursuit, and has forced the Caddis larvæ to build their nests of the most extraordinary substances, such as gold-dust, crushed glass, and other substances. They would not, however, use beads, or anything where the surface was smooth and polished.

In this remarkable sub-aquatic home the Caddis larva lives in tolerable security, for the head and front of the body are clothed in horny mail, and the soft, white abdomen is protected by the case. The food of the Caddis is generally of a vegetable nature, though there are one or two species which live partly, if not entirely, on animal food. When the larva has lived for its full period, and is about to change into the pupal condition, it closes the aperture of its case with a very strong net, having rather large meshes, and lies securely therein until it is about to change into the winged state. It then bites its way through the net with a pair of strong mandibles, comes to the surface of the water, breaks from its pupal envelope, and shortly takes to flight. The larger species crawl up the stems of aquatic plants before leaving the pupal skin, but the smaller merely stand on the cast skin, which floats raft-like on the water.

There are one or two species whose cases are not movable, but are fixed to the spot whereon they were made. In order, therefore, to compensate for the immobility of the case, the larva has a much larger range of movement. In the ordinary species, the creature holds itself to the extremity of the case by means of hooks at the end of its body, which can grasp with some force, as any one knows who has pulled a Caddis larva out of its house. But when the case is fixed, the abdominal claspers of the larva are attached to a pair of long foot-stalks, so that the creature can extend its body to some distance from the entrance of the tube.

THE END









